100MHz LOGIC ANALYZER PM3500

(9499 035 00001)

D-/02 ---/05 incl.

INCL. LOGIC PROBE PM8800

(9444 088 00001)

Instruction manual

9499 503 00602
801015

S&i

Scientific & Industrial equipment division

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Positive feedback

Now you are the user of a Philips test and measuring instrument. We trust that it will give you many years of faithful service. But we would like you to realize one thing: we can only supply the best in T & M equipment with **your** help, user.

We need to know what you have found to be the strong and weak points of this instrument; and we would be very interested to hear about any unusual or elegant applications you have devised for it. Some of this information can be passed on to our design and development departments; and some may be fed back to other users via our bimonthly publication **T & M News.**

May we therefore suggest that you fill in the reply card alongside and send it back to us right now. That way, you'll be helping to provide the positive feedback we need to help you!

All contributions that are published will be paid for at current rates; while as an inducement for you to fill in the reply card, we are offering a free subscription to T & M News or a free copy of Part I of our Digital Instrument Course to all who reply.

Erfahrungsaustausch

Meßgeräte müssen sich in der Praxis bewähren und die in sie gesteckten Erwartungen erfüllen; auch bei Ihnen, dem Besitzer eines Geräts aus der Serie der Philips Test- und Meßgeräte. Wir aber können T & M-Geräte nur zu Ihrer vollen Zufriedenheit herstellen, wenn wir alle Ihre Wünsche kennen.

Deshalb interessiert uns Ihre Meinung über die guten und weniger guten Eigenschaften dieses Gerätes. Außerdem suchen wir Erfahrungen über ungewöhnliche oder neue Anwendungsmöglichkeiten. Vielleicht können Sie unseren Entwicklungs- und Konstruktionsabteilungen einen guten Wink geben; vielleicht können wir Ihre Erfahrungen aber auch in unserer Publikation **Info-dienst** (nur in Deutschland) veröffentlichen, damit auch andere Anwender davon profitieren können.

Deshalb möchten wir Sie bitten, die anhängende Antwortkarte auszufüllen und an uns zurückzusenden. Damit helfen Sie uns, und wir können Ihnen helfen!

Alle veröffentlichten Beiträge werden dem üblichen Tariff entsprechend honoriert. Als Dank für das Ausfüllen der Antwortkarte bieten wir Ihnen ein Freiabonnenment auf Info-dienst (nur in Deutschland) oder ein kostenloses Exemplar von Teil I von unserem Kursus Digital Instrument.

L'intérêt du "feedback"

Vous voilà possesseur d'un instrument d'essai et de mesure Philips. Nous espérons qu'il vous donnera de nombreuses années de bons et loyaux services, mais nous voudrions attirer votre attention sur un point: ce n'est qu'avec **votre** aide que nous pouvons fournir des matériels d'essai et de mesure de toute première qualité.

Nous avons besoin de savoir quels en sont les points forts et les points faibles que vous avez découverts et nous serions très intéressés d'apprendre quelles applications inhabituelles ou élégantes vous lui avez trouvé. Certains de ces renseignements peuvent être transmis utilement à nos bureaux d'études; certains autres peuvent être communiqués à d'autres utilisateurs par l'intermédiaire de notre publication **T & M Informations** (édition française seulement en France).

C'est pourquoi nous vous serions reconnaissants de remplir la carte-réponse à côté et de nous la renvoyer. De cette façon, vous contriburez à nous fournir le "feedback" dont nous avons besoin pour mieux vous servir!

Toutes les réponses publiées seront payées conformément aux tarifs en vigueur; pour vous inciter à remplir la carte-réponse, nous offrons un abonnement gratuit à T & M Informations ou un exemplaire gratuit de la première partie de notre cours sur les instruments numériques à tous ceux qui répondront.

Details of user: **Persönliche Angaben:** **Expéditeur:**

Company/
Firma/Société .....
Department/
Abteilung/Service .....
Street/Straße/Rue .....
Box/Postfach/Boîte Postale .....
City/Stadt/Ville .....
Country/Land/Pays .....
Name/Name/Nom .....
Phone/Telefon/Numéro de téléphone .....

Details of instruments: **Gerätedaten:** **Instrument:**

Name/Name/
Désignation .....
Type number/Typennummer/
Numéro de type .....
Serial number/Serienummer/
Numéro de série .....
Date purchased/Kaufdatum/
Date d'achat .....

What are the main applications for which you use this instrument?
Wofür verwenden Sie dieses Gerät hauptsächlich?
Quelles sont les principales utilisations auxquelles vous affectez cet instrument?
.....
.....

Please, list what you consider to be the **strong points** and the **weak points** of the instrument.
Zählen Sie bitte auf, was Ihrer Meinung nach die **guten Seiten** und was die **schwachen Stellen** dieses Geräts sind.
Veuillez énumérer ce que vous considérez être les **points forts** et les **points faibles** de l'instrument.
.....
.....
.....

Do you have any queries about the use of this instrument? If so, what?
Haben Sie irgendwelche Fragen über die Anwendung dieses Geräts? Wenn ja, welche?
Avez-vous des questions à poser sur l'emploi de l'instrument? Si oui, lesquelles?
.....
.....
.....

I have devised an interesting application for this instrument.
☐ I enclose a brief description (up to about 500 words) of this application
☐ Please send a representative to collect information about the application

Ich habe einen interessanten Verwendungszweck für dieses Gerät gefunden.
☐ Eine kurze Beschreibung hiervon (max. ca. 500 Wörter) erhalten Sie anliegend.
☐ Senden Sie bitte jemanden, der sich an Ort und Stelle über den Verwendungszweck informieren kann.

J'ai trouvé une application intéressante pour cet instrument
☐ Je joins une brève description (500 mots environ au maximum) de cette application.
☐ Veuillez envoyer un représentant à qui nous donnerons des renseignements sur l'application.

☐ I would like to receive **T & M News** regularly.
☐ Please send me Digital Instrument Course Part I.
☐ Ich möchte **Info-dienst** regelmäßig beziehen.
☐ Senden Sie mir Digital Instrument Course, Teil I.
☐ J'aimerai recevoir **T & M Informations** régulièrement.
☐ Envoyez moi la première partie du cours sur les instruments numériques.

PHILIPS

T & M News
N.V. PHILIPS' GLOEILAMPENFABRIEKEN
S & I TQ III - 2
Test and Measuring Instruments Department
Att. Mr. T. Sudar
EINDHOVEN
The Netherlands

please fold

T & M News is your feedback unit

T & M News is a bimonthly publication issued by the T & M Measuring Department of Philips' Science & Industry Division, for distribution to actual and potential users of Philips' T & M equipment. It provides an effective means of exchanging information in the T & M field - both from the manufacturer to the customer and **vice versa.**
Apart from **T & M News** itself, we also issue **T & M Reports,** which provide a vehicle for (generally longer) articles of a more specialized and/or theoretical nature to supplement the information given in **T & M News.** These Reports, being of a more specialized interest, are generally sent to a more restricted group of users; though anyone who is interested can obtain them on request.
One special series that was brought out in supplements to T & M News is our Digital Instrument Course (Part I: Basic binary theory and logic circuits; Part II: Digital counters and timers; Part III: Digital voltmeters and multimeters; Part IV: IEC Bus Interface), which proved so popular with readers that each part of the course has been issued in booklet form.

Info-dienst für Ihren Erfahrungsaustausch

Info-dienst (nur in Deutschland) ist eine Publikation der Philips GmbH Unternehmensbereich für Elektronik für Wissenschaft und Industrie für die jetzigen Besitzer und potentiellen Kunden von Philips T & M-Geräten. Dieses Blatt strebt einen effektieven Informationsaustausch auf dem T & M-Gebiet zwischen Hersteller und Anwender sowie **umgekehrt an.**
Neben diesen **Info-dienst** geben wir auch die **T & M Reports** heraus (nur in englischer Sprache), in denen (im allgemeinen längere) Artikel mehr spezieller bzw. theoretischer Art als Ergänzung zu den Informationen in **Info-dienst** stehen. Diese Reports, an denen in allgemeinen nur Spezialisten interessiert sind, werden an eine begrenzte Anwendergruppe verteilt. Jeder, der daran interessiert ist, kann sie auf Anfrage erhalten.
Eine spezielle Serie, die gerade in den T & M News Supplements erschienen ist, war unser Digital Instrument Course (Teil I: Basic binary theory and logic circuits; Teil II: Digital counters and timers; Teil III: Digital voltmeters and multimeters; Teil IV: IEC Bus Interface). Diese Serie war bei den Lesern so populär, daß jeder Teil von diesem Kursus auch in Buchform herausgegeben wurde (nur in englischer Sprache).

T & M Informations est notre moyen de communiquer mutuellement

T & M Informations est une publication de département de Mesure de Philips, destinée aux utilisateurs effectifs et un puissance d'appareils d'essai et de mesure Philips. Elle constitue un moyen efficace de transmettre de l'information dans ce domaine, aussi bien du fabricant vers le client que **vice versa.**
A part la publication **T & M Informations proprement dite,** nous diffusons les **T & M Reports** (seulement en anglais) qui contiennent des articles (généralement plus longs) de nature plus spécialisée ou plus théorique, destinés à compléter l'information donnée dans **T & M Informations.** Etant donné leur nature, ces Reports ne sont généralement envoyés qu'à un cercle plus restreint d'utilisateurs; toutefois, quiconque s'y intéresse peut les obtenir sur demande.
Nous venons de publier dans les T & M News Supplements une série spéciale d'articles qui constituent un cours sur les instruments numériques (1ère partie: Théorie binaire de base et circuits logiques; 2ème partie: Compteurs numériques et minuteries; 3ème partie: voltmètres et multimètres numériques; 4ème partie: IEC Bus Interface) qui a rencontré un tel succés auprès des lecteurs que chaque partie du cours a été réimprimée sous forme de livret (seulement en anglais).

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IMPORTANT

In correspondence concerning this instrument, please quote the type number and serial number as given on the type plate.

WICHTIG

Bei Schriftwechsel über dieses Gerät wird gebeten, die genaue Typenbezeichnung und die Gerätenummer anzugeben. Diese befinden sich auf dem Leistungsschild.

IMPORTANT

RECHANGE DES PIECES DETACHEES (Réparations)

Dans votre correspondance et dans vos réclamations se rapportant à cet appareil, veuillez TOUJOURS indiquer le numéro de type et le numéro de série qui sont marqués sur la plaquette de caractéristiques.

Note: *The design of this instrument is subject to continuous development and improvement. Consequently, this instrument may incorporate minor changes in detail from the information contained in this manual.*

Bemerkung: *Die Konstruktion und Schaltung dieses Geräts wird ständig weiterentwickelt und verbessert. Deswegen kann dieses Gerät von den in dieser Anleitung stehenden Angaben abweichen.*

Remarques: *Cet appareil est l'objet de développements et améliorations continuels. En conséquence, certains détails mineurs peuvent différer des informations données dans la présente notice d'emploi et d'entretien.*

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Operating manual

1. INTRODUCTION

The PM 3500 Logic Analyzer is a versatile instrument; very useful to examine complex data streams, or signals in digital systems.
The input signals are stored in the build-in 504 words of 16 bits, memory.

The instrument can operate on either an external clock (usually employed when checking data streams, program flow and such) or, the internal clock (enabling detailed checking of timing problems, ringing, reflection and so on).
The clock can be combined with a qualifier.

The capture mode is a feature which allows transients (glitches), appearing in between two clock edges, to be detected.

Three display modes can be selected:

- Timing mode
  The logic signals are displayed as waveforms.
- Table mode
  The logic signals are displayed as words (selectable hexadecimal, octal or binary presentation).
- Map mode
  The value of each input word is converted to a certain value for the X- and Y- coordinates.
  So each different word has his own spot on the display.

Another handy feature is the Compare mode, which allows comparison of a trace table with a pre-loaded reference table.
In the Search mode, the compare function is done automatically, so that a continuously refreshed trace table is compared with the reference table.

Triggering (which stops the intake of data) can be:

- Internally, the trigger word is selectable with the 16 tumbler switches just above the input connectors. Combination of a qualifier is possible.
- Externally, selectable on a positiv- or negative going edge of an external signal.
- Manually, pushbutton action.

Start (which starts the intake of data) can be:

- Automatically
  Repetitive starting of data intake.
  The time between two successive start actions can be controled with the Display Time knob.
- Externally
  With a TTL signal.
- Manually, pushbutton action.

The Logic threshold levels of the input channels are selectable in two groups of eight. One group includes the ext. clock, qualifier and trigger inputs.
The logic threshold levels can be TTL, ECL, or user-selectable (−9 V ... +9 V).
These values apply only when the belonging PM 8800 probes are used.

1.1. CHARACTERISTICS

This instrument has been designed and tested in accordance with IEC Publication 348 for Safety Class I instruments and has been supplied in a safe condition. The present Instruction Manual contains information and warnings that shall be followed by the purchaser to ensure safe operation and to retain the instrument in a safe condition.

This specification is valid after the instrument has warmed up for 15 minutes. Properties expressed in numerical values with tolerances stated, are guaranteed by the manufacturer. Numerical values without tolerances are typical and represent the characteristics of an average instrument.

Specifications for data-, clock-, trigger- and qualifier inputs apply to the tip of the belonging PM 8800 probes.

Data input

Number	:	16 channels
Impedance	:	5 MOhm/13,5 pF
Max. voltage	:	−250 ... +250 V
Threshold	:	Channels 0-7 and 8-15 independent controllable. Pushbutton selection TTL, ECL and variable levels: TTL +1,4 V (⩽ 0,8 V = low; ⩾ 2 V = high) ECL − 1,3 V (⩽ −1,63 V = low; ⩾ −1,065 V = high) VAR − 9 V ... + 9V continuous adjustable. Frontpanel measuring points (R_{int} = 1 kOhm) monitor variable threshold levels.
Max. sensitivity	:	Minimal signal swing 500 mV peak-peak centered at threshold for recording at 100 MHz. (see Fig. 1.1)
Set up and Hold time	:	Set up = 1 nsec. Hold = 2 nsec. with respect to internal active clockedge (see Fig. 1.2)
Pulse width	:	Sample mode: One sample interval + 3ns Capture mode: ⩾ 3 ns with 400 mV threshold voltage overdrive
Skew	:	Channel-to-channel data skew less than 2 nsec.

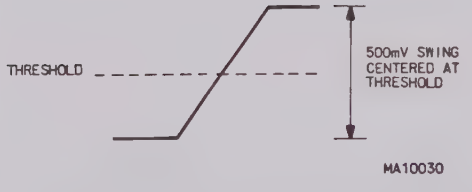


Fig. 1.1. Minimal signal swing

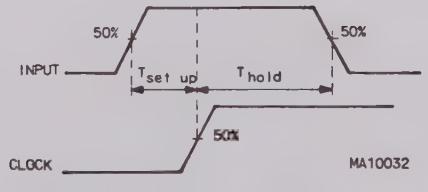


Fig. 1.2. Set-up and hold time

Clock

Source : Selectable internal or external clock.

Internal clock : X-tal controlled
Frontpanel selection 10 nsec ... 20 msec. sample interval with a 20 positions rotary switch in a 1-2-5 sequence.

External clock : Input via PM 8800 probe to frontpanel BNC connector.
Same specifications as data input.
Max. clockrate 60 MHz.
If the clock-rate is less than 50 Hz, the message NO/SLOW CLOCK appears, though the analyzer-functions remains working.
Minimum clockpulse width 5 nsec.
Threshold selection via choice of channels 0 ... 7.
Sampling on positive or negative going clockedge is selectable.
Delay between external clock input and data input = 15 nsec typical.

Clock qualifier : Input via frontpanel BNC connector.
Same specifications as data input.
Threshold selection same as channels 0 ... 7.
From version -/03 upwards, the threshold can also be set to TTL, separate from channels 0 ... 7.
Sampling only occurs if qualifier is "true" at clockedge.
"True" is selectable for high ("1") or low ("0") level.
In don't care ("X") position not in use.
Set up time = 4 nsec. Hold time = 3 nsec. with respect to actual clockedge at probe tip.

Trigger

Source : Selectable internal, external and manual.

Triggering : Sample mode:
Triggering on signals having pulse widths of one sample interval +3 ns.
Capture mode:
Triggering on glitches $\geqslant$ 3 ns.

Internal : Triggerword recognition on 16 channels and trigger qualifier.
Combination of the high-speed triggerword is defined by 16 switches with the positions "1", "0" and "X" (don't care).
Triggering occurs if there is a match between an input data word and selected combination.

External : Input via frontpanel BNC connector.
Same specification as data input.
Threshold selection same as channel 0 ... 7.
From version -/03 upwards, the threshold can also be set to TTL, separate from channels 0 ... 7.
Triggering selectable on positive- or negative going edge of trigger signal.

Manual : Triggering occurs via frontpanel pushbutton.

Trigger qualifier : Identical to external trigger specification but used in combination with internal triggering selection ("INT").
Triggerword is conditioned by trigger qualifier "true".
"True" is selectable for high "1" or low "0".
In don't care ("X") position not in use.

Trigger delay : The trigger can be delayed by 0 ... 9999 clockpulses set by a variable counter control.
Delayed record modes such as centre- and post- and delayed triggering can be accurately executed by this single control.

START

Source : Selectable automatic, external and manual.

Automatic : The instrument automatically starts itself in a frequency which is dependent on display time setting from approx. 1 up to 10 sec. ± 20 %.

External : Start request can be given by external pulse on frontpanel BNC-input.
TTL level only on logic "0" level during ⩾ 40 ms.
(internal pull-up resistor 2,74 kOhm to +5 V).

Manual : Start occurs via frontpanel pushbutton.

MEMORY : The memory length is 504 words.
In the Compare mode the memory is divided into two sections of each 248 words.
One word is 16 bits.

OPERATION MODES

Sample mode : The input signals are simultaneously clocked into the memory at the sample clock transitions with respect to the selected threshold.
Minimum pulse width always recorded is one sample interval +3 nsec. with 250 mV or more threshold voltage overdrive.

Capture mode : Glitches shorter than one sample interval or as narrow as 3 nsec. with a threshold voltage overdrive of 400 mV (4 ns. with 250 mV).

It holds the captured glitch until the next clockedge and displays it for one sample interval.

Compare mode : Half of the memory is reserved for storing reference data.
In the state table display modes both trace- and reference tables are displayed.
Unequality within the 248 words captured data is indicated in the heading by the message "UNEQ" and in the table by intensified digits.

Store Ref. : The reference data is acquired, stored and displayed.
Reference data will be stored until Compare mode is reset.

Search mode : Data is automatically, continuously acquired in the 248-word trace memory and compared with stored data.
When an unequality occurs acquisition stops and the table belonging to the last captured data together with the reference data are displayed.
Unequalities are intensified. First line of display (cursor) shows first found unequality.
The number of searches is counted and displayed in the heading.

DISPLAY

Tube : Philips D18 - 120 GH
10 x 12 cm 10 kV tube with electrostatic deflection.

Screen type : P31 (GH)
Focus and intensity adjustment on frontpanel.
In the upper parts of the display a clear heading will continuously be displayed showing the state of the instrument and essential parameters.

Trace rotation : Internal adjustable.

Cursor : The cursor serves as a reference in the captured data and is controlled by 3 pushbuttons: two to determine the direction in increments of one sample interval, or continuosuly and one for fast operation.
The cursor contains 16 words.
The first word is the actual cursorword, displayed in the summary together with its line number for positioning purposes. The line number is the relative distance (in samples) of each word to the trigger word.

Display modes

Time : 16 channels grouped in 4 groups of 4 horizontal timing diagrams.
Expand: Time axes can be expanded by pushbutton control 10 and 25 times.
The cursor word serves as the starting word in expanding time displays.

Tabelling : Binary, Hexadecimal and Octal state table selection.
The 16 words contained by the cursor word are displayed. The words are preceeded by the line numbers.
Cursor position is given by line number of the first word.

Map : Each word is represented as a unique dot on the screen by displaying the least significant word half along the horizontal axis and the most significant word half along the vertical axis.
The cursor is indicated by a "O" sign and is read out in the heading.
The brightness of the dots indicates the frequency of occurence within the captured data.

Blank : Display of the channels can be suppressed in sequence starting with channel 15 by pushing the blanking "+" button.
Recalling occurs with the blanking "—" pushbutton.
In Time mode the remaining channels are regrouped, in units of 4 channels over the entire display.
In the Tabel modes blanking results in suppression columns from left (ch. 15) to right (ch. 0).
In the Map mode blanking shrinks the map step wise from 8 by 8 bits, 7 by 8, 7 by 7, etc.
Because the entire screen is used an expanded map view is obtained.

OUTPUTS

Via BNC connectors at rear side.

Start out : TTL level, low-high transition at start moment after initialisation

Trigger out : ECL level, low-high transition at trigger moment.

See also Fig. 2.3.6.

POWER SUPPLY

Power consumption : 110 W 160 VA

Line voltages and frequencies : 110 - 127 V_{ac} ± 10 %
220 - 240 V_{ac} ± 10 %
48 - 440 Hz
} Mains fuses 3,15 A delayed (2x) both line voltage ranges.

Safety requirements : According IEC 348 Safety Class I standard.

ENVIRONMENTAL CHARACTERISTICS

The characteristics are valid only if the instrument is checked in accordance with the official checking procedure. Details on these procedures and failure criteria are supplied on request by the PHILIPS organisation in your country, or by N.V. PHILIPS' GLOEILAMPENFABRIEKEN, TEST AND MEASURING DEPARTMENT, EINDHOVEN, THE NETHERLANDS'

Ambient temperature	:	−10 °C ... +40 °C operating −40 °C ... +70 °C storage and transport
Humidity	:	21 days cyclic damp. heat +25 °C ... +40 °C; R.H. 95 %
Shock	:	30 g; half sine-wave shock of 11 ms duration; 3 shocks per direction for a total of 12 shocks.
Vibrations	:	3 g vibrations in three directions with a max. of 15 minutes per direction; 10 minutes with a frequency of 15 ... 25 Hz and amplitude of 1 mm p-p. 5 minutes with a frequency of 25 ... 55 Hz and an amplitude of 0,5 mm p-p.

DIMENSIONS AND WEIGHT

Height	:	200 mm
Width	:	386 mm
Depth	:	470 mm
Weight	:	14 kg.

ACCESSORIES SUPPLIED

- Five PM 8800 probesets each containing 4 logic probes.
- Operating-Service manual.

OPTIONAL ACCESSORIES

- Logic Trigger Probe PM 8810.

2. DIRECTIONS FOR USE

2.1. CONTROLS, CONNECTORS AND INDICATORS

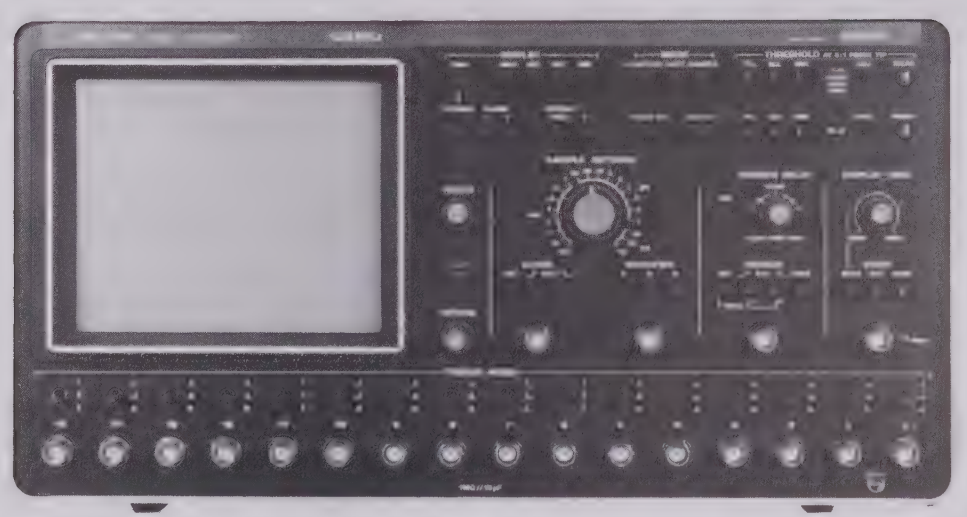


Fig. 2.1. PM 3500 Frontview

CRT

INTENS - OFF	:	Combined functions power on-off switch and intensity adjustment.
FOCUS	:	Focus adjustment
POWER ON	:	Pilot lamp

DISPLAY

TIME	:	Pushbutton selecting the timing diagram
MAP	:	Pushbutton selecting the mapping mode
HEX	:	Pushbutton selecting the state table mode in hexadecimal format. The content of the cursor is displayed.
OCT	:	Pushbutton selecting the state table mode in octal format. The content of the cursor is displayed.
BIN	:	Pushbutton selecting the state table mode in binary format. The content of the cursor is displayed.
EXPAND	:	Pushbutton permitting successively selecting of time expand X1, X10 and X25 modes.
BLANK	:	Two pushbuttons "+" : the data presentation channels are blanked starting at channel 15 as long as this button is activated. "–" : the blanked channels are displayed again in reversed direction as + button.

CURSOR : Three pushbuttons

"–" : the direction of the cursor is to the left in timing mode and upwards in the table modes.

"+" : the direction of the cursor is to the right in timing mode and downwards in the table modes.

FAST : If one of the direction buttons is activated together with the fast button the cursor will run 15x times faster.

. Both single step and (after some delay) continuous run capability.
. The content of the cursor is 16 words.

MODE

SAMPLE : Pushbutton
Data is sampled with selected sample interval (internal) or with extern clock rate.

CAPT : Pushbutton
In this mode data with a minimum pulse width of 3 nsec. that occurs between the clock transitions can be captured, and are displayed during a next sample interval.

COMP : Pushbutton
. The memory is divided into two equal parts of 248 words, of which one can be used to store a reference table.
. The display can show in the tabelling modes two tables of 248 words length. If the tables are not equal the faulty bits in the trace table are intensified.

In the compare mode the following controls can be used:

STORE REF : Pushbutton
Start recording to storage in reference memory.

SEARCH : Pushbutton
Start automatic recording by which all data are referred to reference table.
Recording stops if at least one bit is unequal.

THRESHOLD

Threshold part consists of two equal groups of controls which are:

TTL : Pushbutton selecting a threshold of the input comparator to allow TTL logic measurements.

ECL : Pushbutton facilates ECL logic measurements.

VAR : Pushbutton allowing a threshold adjustment variable from –9 V up to +9 V.

ADJ. : Screwdriver adjustment for variable threshold.
MEAS : Output of adjusted voltage.

: One group control inputs : – channel 0 ... 7
– clock
– clock qualifier
– trigger

: Other group controls : – channel 8 ... 15

CLOCK

INT : Pushbutton selecting internal sampling clock.

EXT : " ⌐ " pushbutton: selects external clock for positive going edge.
" ⌙ " pushbutton: selects external clock for negative going edge.

Input: BNC-connector for qualifier (1 MOhm, 15 pF, max. voltage + or –50 V continuous).

SAMPLE INTERVAL : 20 positions rotary switch in a 1-2-5 sequence.
Sample interval selector from 10 nsec. –20 msec. for internal clock.

Qualifier : Clock qualifier facility which gates the internal or external clock.

"1" pushbutton selects "true" for a high level
"0" pushbutton selects "true" for a low level
"X" pushbutton: qualifier is not used.

Input: BNC-connector for external trigger pulse (1 MOhm, 15 pF, max. voltage + or –50 V continuous).

TRIGGER

INT : Pushbutton selecting internal triggering via word recognizer.

EXT : " ⌐ " pushbutton: external triggering on positive going edge.
" ⌙ " pushbutton: external triggering on negative going edge.

Input: BNC-connector for external clock (1 MOhm, 15 pF, max. voltage + or - 50 V continuous)

MAN : Manual stop of recordings.

TRIGGER DELAY : . "ON pushbutton": selects use of trigger delay.
. Knob "– STOP +" serves to choose trigger delay.

"+" counts up
"–" counts down

. If knob is pushed delay setting runs 100 times faster.

START

AUTO : Pushbutton selection for automatic start.

DISPLAY TIME : knob, adjusting display time from 1 up to 10 sec.

EXT : Pushbutton. External start on negative going TTL pulse via BNC input.

MAN : Manual start of measurements.

Input: BNC-connector for external start.

TRIGGER WORD

1
X
0 : 16 three position switches enables the operator to choose a trigger word. If a match occurs between inputs and selected trigger word the word recognizer provides a trigger pulse.

2.2. MAKING OPERATIONAL

This section outlines the procedures and precautions necessary for installing the PM 3500, identifies, and briefly describes the functions of the front and rear panel controls and indicators, and explains the practical aspects of operation to enable an operator to evaluate quickly the instrument's main functions.
This instrument is protected according to the IEC 348 Class I standard safety regulations.

Mains adjustment and fuse

Set the mains adaptor switch, located behind the rear plate, to the relevant supply voltage range(see Fig. 2.2.). The two fuse-holders which are mounted on the rear panel, carry 3,15 A delayed action fuses. Ensure that only fuses with the required rated current, and of the specified type are used for replacement. The use of mended fuses and the short-circuiting of fuse-holders shall be avoided. The instrument shall be disconnected from all voltage sources when a fuse is to be replaced.

Earthing

Before switching on, the instrument shall be connected to a protective earth conductor in one of the following ways:

- via the protective earth terminal at the rear (identified by the symbol ⏚).
- via the earth wire in the three-core mains cable.

The mains plug shall only be inserted in a socket outlet provided with a protective earth contact. The protective action shall not be negated by the use of an extension cord without protective conductor.
Replacing the mains plug is at the user's own risk.

WARNING: Any interruption of the protective conductor inside or outside the instrument, or disconnection of the protective earth terminal, is likely to render the instrument dangerous.
Intentional interruption is discouraged.
When an instrument is brought from a cold to a warm environment, condensation may cause a hazardous condition. Ensure, therefore, that the earthing requirements are strictly adhered to.

Installation

Before any other connection is made, to protective earth terminal shall be connected to a protective conductor (see section EARTHING).

WARNING: The opening of the covers or removal of parts, except those to which access can be gained by hand, is likely to expose live parts and accessible terminals, which can be dangerous to life.

The instrument shall be disconnected from all voltage sources before any adjustment, replacement or maintenance and repair is effected with the instrument open. If afterwards any adjustment, maintenance or repair of the opened instrument under voltage is inevitable, it shall be carried out only by a skilled person who is aware of the hazard involved. Bear in mind that the capacitors inside the instrument may still be charged even of the instrument has been separated from all voltage sources.

Cooling

Take care that the natural air flow through the instrument is not obstructed.
Do not place any instruments or papers on top of the instrument to avoid excessive heating-up.

Overload protection

In case of any circuit over current (possible due to excessive temperature) the build-in power supply circuit switches off; the POWER lamp is off. The same might happen when the mains voltage is successively interrupted.
In this case switch-off the mains voltage with the front panel POWER switch, and let the instrument cool-down for at least 5 minutes, and switch-on again.

Carrying handle

The handle can be rotated if the pushbuttons on its bearings are depressed.

Switching-on

The POWER switch is incorporated in the INTENS control on the front-panel. The instrument may never be switched on whilst any circuit-board or circuit-component is removed.
Never remove a circuit-board or component until the instrument has been switched-off for at least one minute.

Power-on test

When switching-on, the microprocessor initiates a test program to check the immediate microprocessor environment.

Service test

The instrument is provided with a test program to pin-point any functional defect.
This program is selected with a switch, located on the microprocessor circuit board.
For more information refer to the "Service" part of this manual.

Initial setting

Following modes or values are automatically set, when switching-on:

- TIME display mode X1
- All 16 channels on
- Cursor on beginning of the memory
- Trigger delay 503 (if button ON depressed).

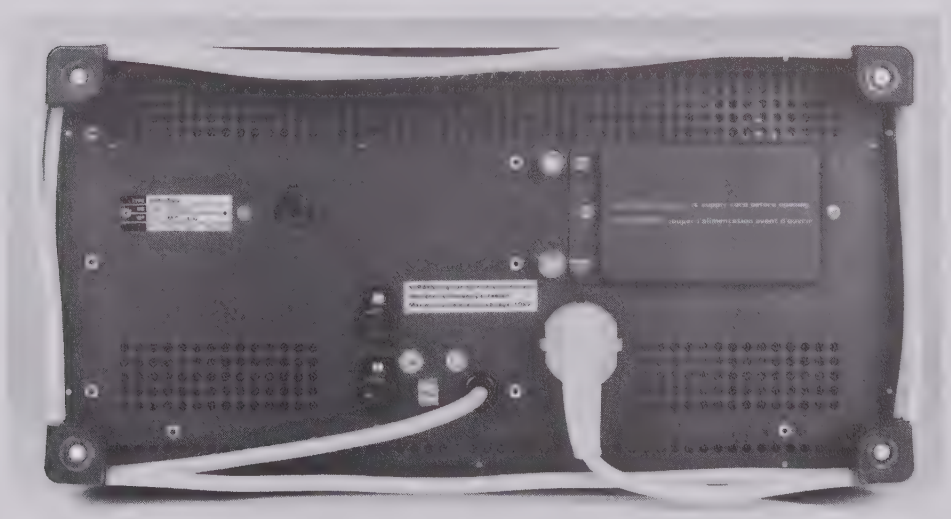


Fig. 2.2. Rear View, Mains adaptor switch and fuses

2.3. OPERATING

Input

The signals which have to be displayed must be applied to the front panel inputs 0 ... 15 via the PM 8800 probes. If not all inputs are required, start connecting-up from input 0 (refer also to chapter "Blank").
Correct earth connection of each input probe is strongly recommended.

Threshold

To achieve proper detection of the input signal levels, the threshold voltage must be correctly set.
This is automatically done for the TTL or ECL levels; also a variable threshold (VAR) has been build-in.
Note that the threshold values only apply if the PM 8800 probes are used, which have a voltage attenuation of 1:5.
To set the threshold value in the VAR mode connect a voltmeter to the output tag MEAS belonging to the relevant input and adjust the corresponding potentiometer (screwdriver adjustment).
Note that the threshold value can be selected for inputs 0 ... 7 and for inputs 8 ... 15, separately. The threshold value selected for inputs 0 ... 7 applies also for the inputs: CLOCK, CLOCK QUALIFIER and TRIGGER.
The EXT. START input suits for TTL levels only.
From version -/03 upwards, the EXT TRIG/TRIG QUAL input and the CLOCK QUAL input can be set to TTL, independent of the threshold setting of channels 0 ... 7.
This is done with jumpers on the microprocessor board as indicated in fig. 2.3.1.

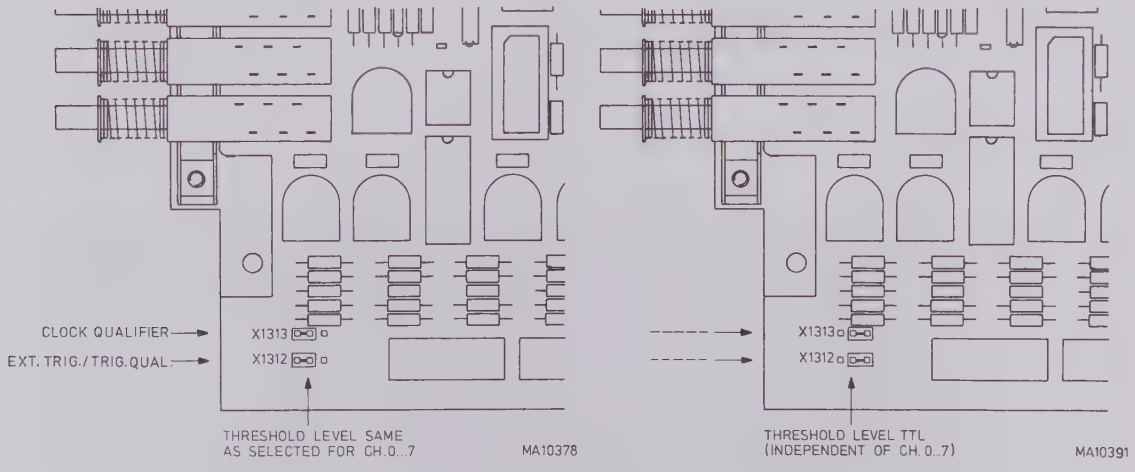


Fig. 2.3.1. Level setting of the EXT TRIG/TRIG QUAL input and the CK QUAL input from version -/03 onwards.

Clock input

The clock is a repetitive signal, which estimates the frequency of samples taken of the input signals. Each clock edge, a sample of the input signals is taken and stored in the memory of the PM 3500.
The above action is started by the START function and stopped by the TRIG function.

EXTernal clock

The clock signal can be taken from the clock generator present in the system which must be tested.
This is called synchronous clock, because the analyzer sample actions run synchrone with the system under test. The clock action can be selected at the positive or negative going edge of the system clock.
The external clock mode is commonly employed for software problems such as program flow and so on.
The parameters for the external clock input connection, are according to those of inputs 0 ... 7.

INTernal clock

The internal clock has the advantage that in general the samples taken from the system under test can have a much higher frequency rate than the system clock. This allows closer inspection of timing problems, pulse edge comparison etc. and is also called asynchronous clock.
The sample rate can be selected with the knob SAMPLE INTERVAL between 20 ms and 10 ns (50 Hz up to 100 MHz) in steps of 1, 2 and 5.

Clock qualifier

The clock qualifier allows more selective data acquisition by gating the clock with an additional condition which can be "1", "0" or "X" (don't care). Selectable with the buttons QUALIFIER 1, X or 0.

Start

The start function controls the moment at which the analyzer starts taking in data, and can be initiated in three ways:

- AUTOmatic
- EXTernally
- MANual

In the automatic mode (depress AUTO button) renewed taking-in of data occurs every 1 ... 10 seconds, adjustable with the DISPLAY TIME control knob.
External start (depress button EXT) is possible with a separate negative going TTL signal applied to the relevant socket on the frontpanel.
Manual start is effected by pushing the MAN button.

Triggering

The trigger action stops the intake of the data stream, so that the input data memory contents remains stable, and is available to be displayed on the screen.
As trigger source can be choosen: a certain selected word occuring in the input data stream (internal triggering); or an externally applied signal; or manual.

INTernal triggering

Triggering takes place if a certain preset trigger word is recognised in the data stream (depress the INT button). This triggerword consists of a combination of logic "1" and "0" 's, which is selected by the switches directly above the data input connectors.
Select for input channels which are not used, or of which the bit information is not important, the X-position (don't care) of the corresponding switch.
Internal triggering can be combined with trigger delay and trigger qualifier (see Fig. 2.3.2.).

EXTernal triggering

Triggering takes place by an external signal, selectable for positive-, or negative going edge, applied to the frontpanel trigger connector (depress one of the two EXT buttons), see Fig. 2.3.2.
External triggering can be combined with trigger delay.

MANual triggering

Triggering takes place by pushing the MAN-button; this overrules all other trigger conditions (the trigger delay as well). Manual triggering is useful to display captured data, even if the triggerword is unknown or unfindable.

Trigger Delay

By pushing the ON button the trigger delay is switched on. The trigger delay is a number of clock pulses, elapsing between appearance of the trigger word or external trigger signal, and the actual moment of triggering, see Fig. 2.3.3.
When switching-on the trigger delay is automatically set to 503; this means that the complete memory is refreshed with data which appeared just after the trigger word (or trigger signal).

The trigger delay value can be set between 0 and 9999 with the TRIG DELAY rotary control (in the STOP position this value remains stable), and is shown in the heading of the display.

If the trigger delay is switched-off (reset the ON button) or the trigger delay has been set to 0, triggering takes place, at the same moment that the trigger word is present on the data inputs. In this case the memory contains data which appeared just before the trigger word (or trigger signal).

Automatic paging through a program, can be obtained as follows:

- select the AUTO start mode with a display time of e.g. 5 seconds
- set the TRIG DELAY such, that every 5 seconds the trigger delay value has increased (or decreased) a number of approx. 10.

In such a way a continuous flow through the program of the system under test is obtained.

Trigger Qualifier

The trigger qualifier is meant as an extra conditional signal for the selected internal triggerword and can be choosen by the switches TRIGGER QUAL 1 or 0.
This input has the same parameters as the dat inputs, provided with glitch capture, and can be seen as a 17th channel for trigger recognition.

The trigger qualifier allows more selective data acquisition by gating the trigger signal with an additional condition which can be "1" or "0".
Connecting the trigger extension probe PM 8810 to this input extends the trigger selection capacity.

Cursor

The cursor is a selectable 16 word long part of the memory.
The first word of the cursor is the actual cursor word.

In the TIME mode the cursor is the intensified part of the timing diagram.
The position of the cursor word with respect to the selected triggerword (or trigger signal) is indicated in the heading of the display.

In the TABLE mode the complete cursor contents is displayed. The first word of the table is the cursor word.

In the MAP mode, the dot which corresponds with the cursor word is enclosed in a "O" sign.
The position of the cursor word with respect to the selected triggerword (or trigger signal) is indicated in the heading of the display.

The cursor can be moved through the memory step-wise, continuously or fast.
Pressing the button CURSOR + or — shortly, the cursor moves only one word in the memory. Keeping these button depressed gives a continuous shift through the memory. If the FAST button is depressed at the same time, the shift speed is increased.
The cursor can be positioned anywhere in the memory and can therefore be used to "roll" through the captured data stream.

The cursor is in fact used as a viewing-aid, and as a convenient cross-reference when switching over from timing display to data display.

Blank

The blanking function is used to select the number of input channels to be presented on the display.
Note, that the blanking function has no influence on the data acquisition and trigger selection.

In the TIME mode the remaining channels are regrouped in units of 4 channels over the entire display.

In the TABLE mode blanking "+" results in the suppression of columns from left (ch. 15) to right (ch. 0); the suppressed channels are in the HEX or OCT tables effectively replaced by 0's.

In the MAP mode blanking "+" shrinks the map in steps (8 by 9; 7 by 8, 7 by 7, 6 by 7, etc.).
So independent of the selected number of channels, always the entire display is used.

Display

The c.r.t. display shows the various signal data, and an explanatory text (heading), depending on the selected display mode and analyzer mode.

Three main groups of display modes are selectable.

Time

When the TIME button has been pushed the logic signal levels are shown related to the horizontal time axis, so that clearly the time relation ship between the signals is shown.
To obtain full use of the timing diagram it is necessary to use a sample interval clock frequency which is at least 5 to 10 times higher than the clock frequency of the system under test.
Depress button CLOCK INT. The frequency can be selected with the SAMPLE INTERVAL rotary switch.
As there is no direct relationship between the clock of the system under test and the interval clock of the analyzer this is also called; "asynchronous clock".
The sample intervals are indicated by the "clock ticks".
At "0" levels the clock ticks are positive-going, at "1" levels negative-going.

Fig. 2.3.4. Clock ticks

In the TIME mode the time axis can be magnified by pushing the EXPAND button.
The expand rates are x1, x10, x25 successively.
In the x10 and x25 modes the cursor word is the first word of the timing diagram.

The heading in the TIME mode shows:

- the expand rate
- the selected trigger delay
- the position of the cursor word with respect to the trigger word.
- the contents of the cursor word the notation can be hexadecimal, octal or binary, depending on which of the HEX, OCT or BIN buttons had been selected.

Each data channel is identified with its channel number at the lefthand side of the display.

Table

The data presentation is in characters (after pushing the HEX, OCT or BIN button), with the parallel data words arranged horizontally; the sequence being from top to bottom.

This mode is usefull for so-called "synchronous clock" measurements.

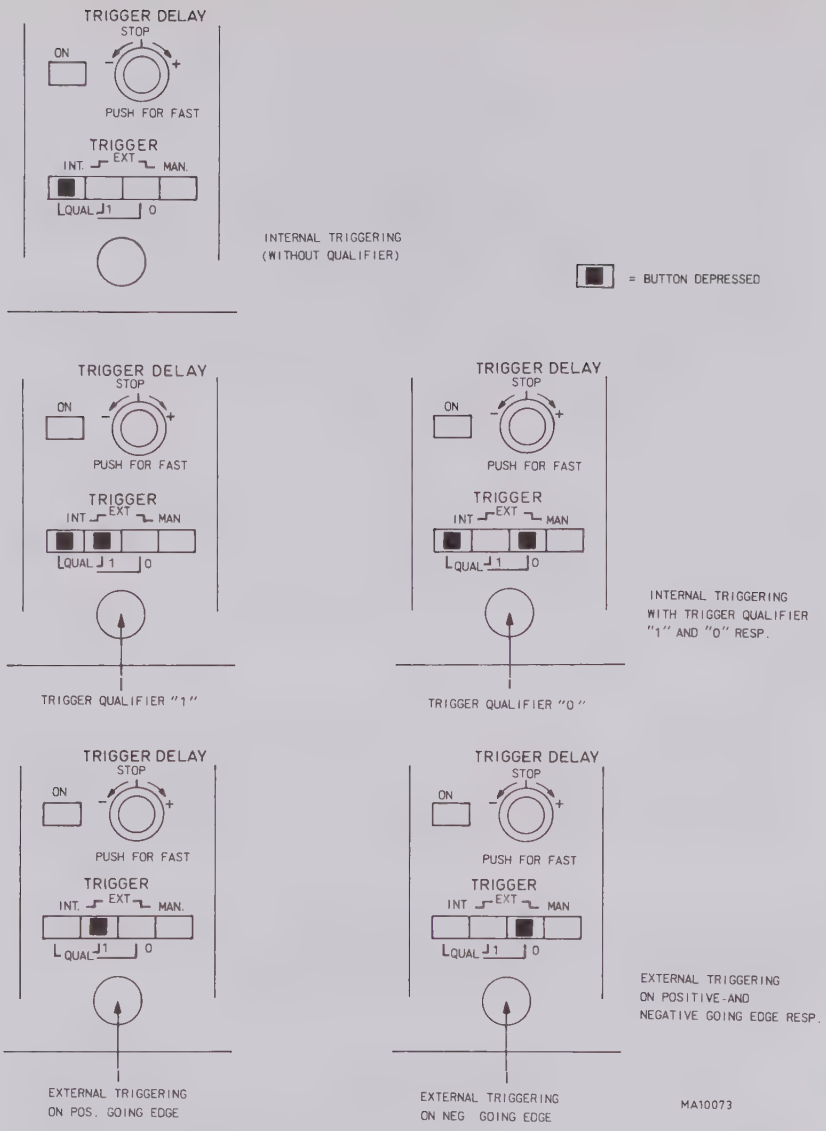


Fig. 2.3.2. Trigger button functions

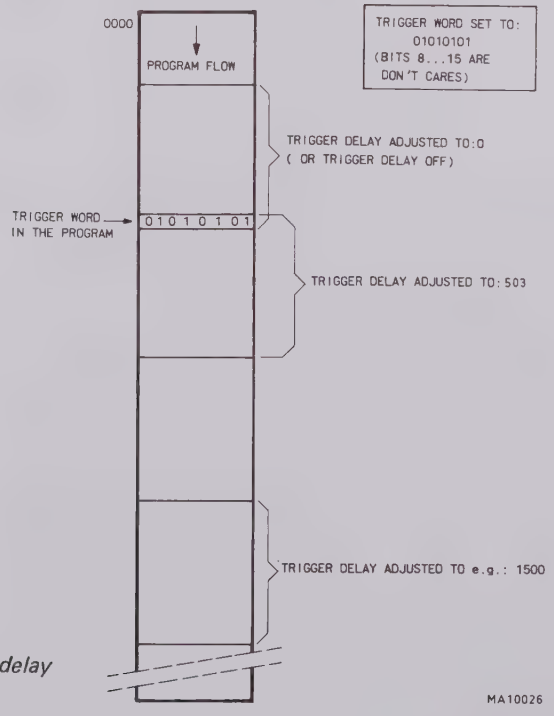


Fig. 2.3.3. Trigger delay

The display shows the complete cursor contents (the first word is the cursor word).
The heading in the TABLE mode shows:

- the selected presentation mode
- the selected trigger delay
- indication which channels have been selected.

Each data word is identified with its numerical relation to the trigger word.

Map

After pushing the MAP button, the data words are converted to coordinate values represented by dots on the screen. Each data word has its own specific place on the screen.
The least significant half of the word is plotted along the X-axis (horizontal), and the most significant half of the word is plotted along Y-axis (vertical).
The obtained dot pattern is a signature representing the whole captured data block.

The dot which corresponds with the cursorword is enclosed in a 0.

Dots which are repeatedly written have proportional higher brightness, so that words which appear more times in the data block easily can be recognized.

When blanking channels, the remaining number of channels are equally divided over the X- and Y-axis so that always the whole surface of the screen is in use.

The heading in the MAP mode shows:

- the selected presentation mode
- the selected trigger delay
- the position of the cursor word with respect to the trigger word.
- the contents of the cursor word (the notation can be hexadecimal, octal or binary, depending on which of the HEX, OCT or BIN buttons had been selected before).

Analyzer Modes

Two main modes are selectable:

- SAMPLE or
- CAPTURE

each of these modes can be combined with the COMPARE function or not.
See Fig. 2.3.5. for sample- and capture modes.

Sample

This is the basic analyzer mode, in which data are taken in at each clock edge (depress the SAMPLE button).
Data intake can be synchronous (clock signal taken from the system under test) or asynchronous (with the analyzer's build-in clock generator).
Data intake starts at the START function and stops at the TRIG action.
The data which are in the memory of the analyzer, can be displayed in either the TIME, TABLE or MAP mode.

Capture

The CAPTURE mode (selected by depressing the CAPT button) is in fact the same as the SAMPLE mode, but now, also pulses (glitches) appearing between two clock edges are detected. Both, positive-going glitches during "0" levels and negative-going glitches during "1" levels are detected.
Glitches are captured until the next clock-edge, and displayed for one sample interval.

The capture facility can be used in "slow" data streams, to catch transients without increasing the clock rate. Since the detected glitches are converted by the circuitry into proper pulses, it is possible to set a trigger word having the same logic state as those that result when the glitch occurs.

Note that the glitch capture capability also applies to the EXT TRIG input.

Compare

By depressing the COMPARE button two data streams can be compared.
The memory of the analyzer is now split-up in two parts (both 248 words deep).
One part is the trace memory with the normal place on the screen, and the second part is the reference memory displayed next to the trace data table.

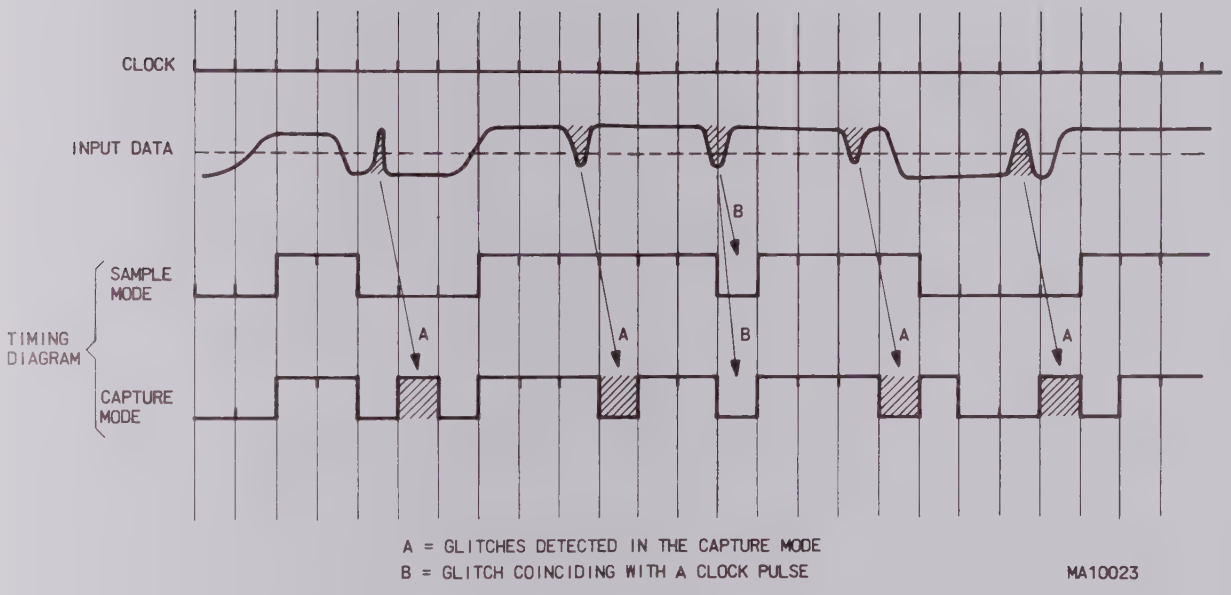
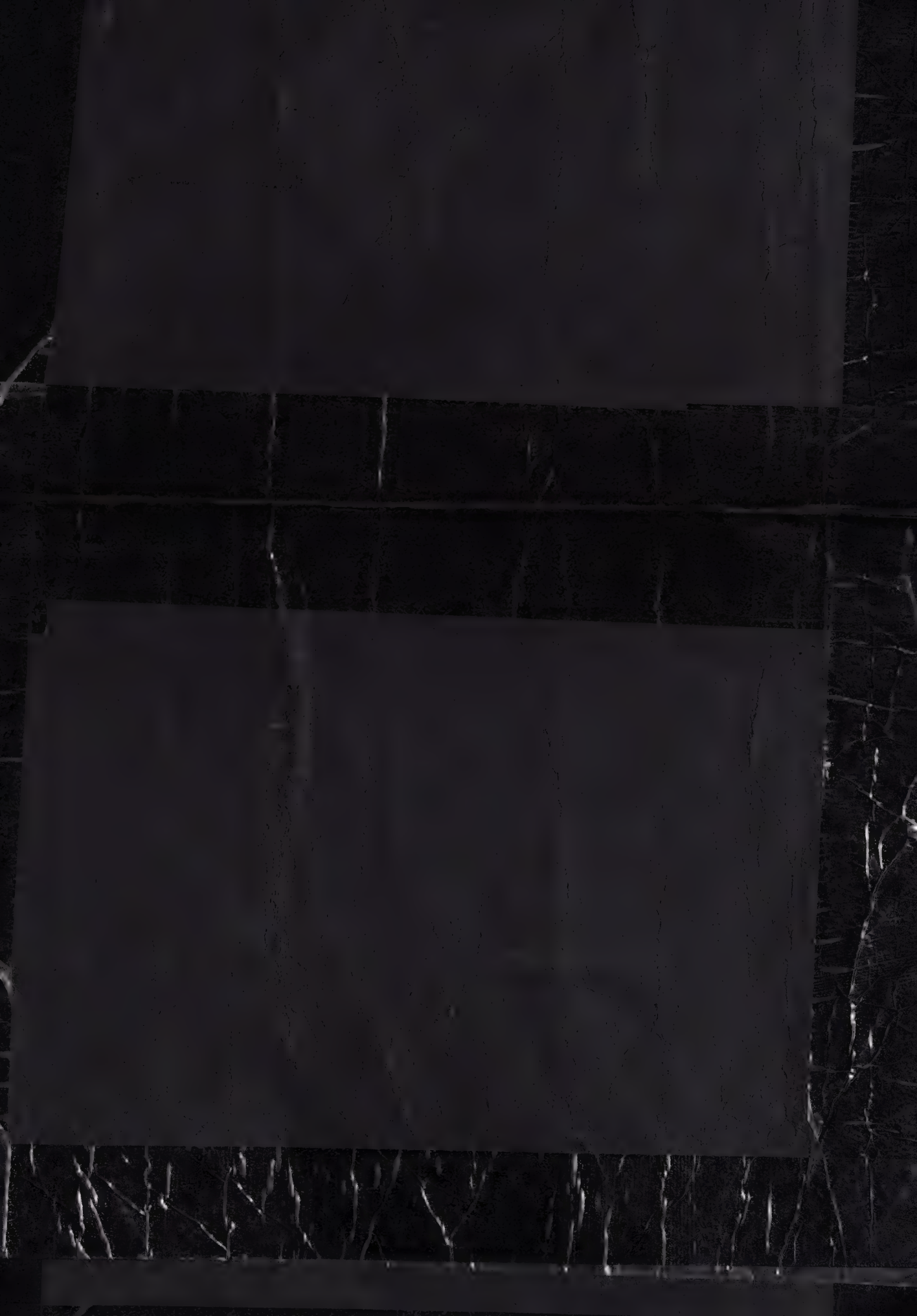


Fig. 2.3.5. Some exemples of glitch-capture



The compare mode is principally meant for the TABLE mode.
If it is necessary to make use of the full memory capacity, for tracing data which appear just after the trigger-word a trigger delay setting of 247 is recommended.
The reference memory is filled with data by pushing the STORE REF button (this is the start function); as soon as the trigger condition is present the reference table is displayed.
The trace table is obtained by the standard start and trigger functions.

Any inequality between the two captured data blocks is indicated by intensified characters in the trace table. Also in the heading appears the intensified UNEQ message, if at least one bit is the whole trace memory is different.

The heading in the COMPARE mode shows:

- the selected presentation mode
- the selected trigger delay
- indication which have been selected
- the result of the compare function:
  . EQ if both captured blocks are complete the same;
  . UNEQ if at least one bit is different.

Escaping from the COMPARE mode is realized by resetting the COMPARE button.

Search

The search mode is an automatic compare mode, very useful for data which might differ only incidentally.
The reference data are acquired as described under COMPARE.
If now the SEARCH button is pushed the display shows only the heading.
The AUTO start button may not be depressed.
When the trigger condition for the trace table is found the search count number is incremented and both tables are compared by the instrument. If no difference is found the instrument restarts again and waits for the next trigger condition and so on.

As soon as any difference between the trace data and the reference data is detected, the search action stops, the display shows both tables arranged such a way that the first faulty data word is in the cursor word and the faulty bit is intensified. The instrument is now back in the compare mode.

The repetition rate of the search mode is approximately 10 Hz. If necessary the START out signal at the rear panel of the analyzer can be used to start the program of the system under test.

The heading in the SEARCH mode shows, if the trace data are equal to the reference data:

- HEX, OCT or BIN TABLE SEARCH, and the number of searches which have been executed.

  If unequal: also the selected trigger delay is shown in the heading.

The search mode can be aborted by depressing the Search button again.

Rear panel outputs
See also Fig. 2.3.6.

START out

On this output is a positive-going TTL signal available at the actual start moment.
This signal can be used to start the program of a system under test synchrone with the analyzer.

TRIGGER out

On this output is a positive-going ECL signal available at the actual trigger moment +4 clock-pulses, (in the CAPTURE-mode one pulse less).
The delay between manual triggering and the TRIG pulse is unpredictable, but max. 10 pulses.
This output signal can be used e.g. to trigger a real-time oscilloscope.

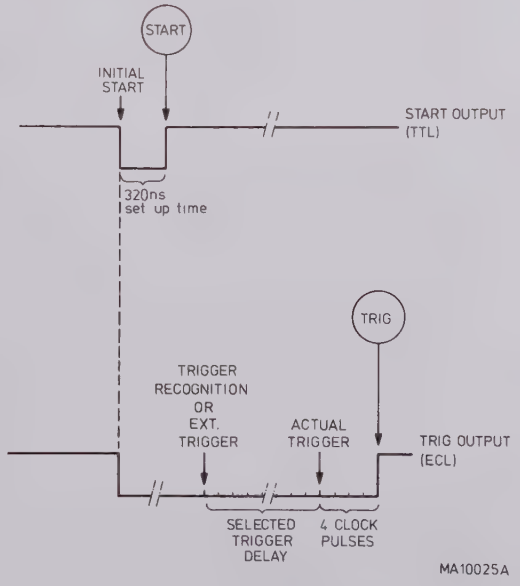


Fig. 2.3.6. Rear panel outputs

Remarks

Basically in logic analyzer use the following applies, if the trigger delay is less than the memory depth (or trigger delay is switched-off).

If the number of words (input samples) between the startmoment and the recognition of the triggerword + trigger delay, is less than the memory depth, the memory area before the triggerword will not be completely refreshed with new data.

As there is no time relation between the startmoment (manual start, auto start or search) and the triggering, the number of inputsamples between the startmoment and the triggering is unpredictable (the triggerword might occur directly after the startmoment so that, with no trigger delay, only the triggerword is in the memory).

To obtain data streams of equal length after the startmoment, the START-out signal of the analyzer can be used to start the system-under-test, or a start signal from the system-under-test can be applied to the EXT. START input of the analyzer.

In this way the number of samples between the startmoment and the triggering is predictable.
Especially in the SEARCH-mode this method is very useful.

In the PM 3500, at each start moment the complete data memory is cleared (set to all 1's) however the input circuits which process the input signals to the memory, are not cleared.

As an example of this a display is shown in Fig. 2.3.7.
In this figure the top three words (FFFF) in the table represent a part of the memory that is not refreshed at all by data.
The next group of words are non-valid data which were still in the input circuitry from the preceding measurement. This group is 12 samples max.
The remaining group is actual data.

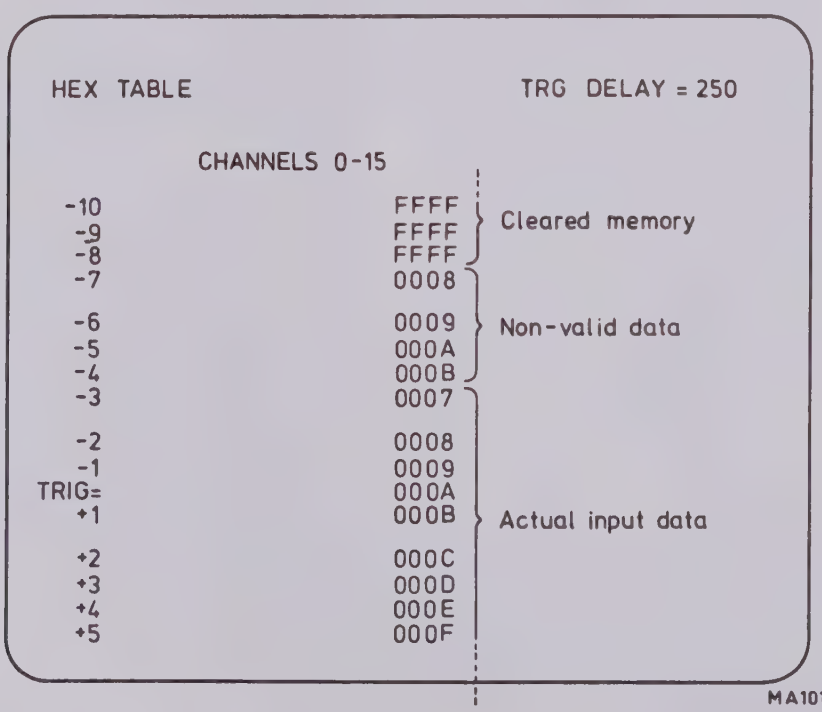


Fig. 2.3.7. A number of non-valid data may appear on the display before the actual data, if the trigger delay is less than the memory depth.

2.4. MAINTENANCE

From experience it is expected, that this instrument operates within its specifications for a period of at least 1500 hours of operations or, nine months if used infrequently. However, to ensure reliable and troublefree operation, the instrument should not be exposed to moisture, heat, corrosive elements or excessive dust.

The appearance of the top and bottom cabinet plates, lacquered with Nextel sued coating will deteriorate after some time. To clean it, use a soft cleansing pad with some ethanol or common household cleaning detergent. Abrasive cleaning pads or materials should not be used, otherwise surface scratches will result.

WARNING: The Nextel sued coating is ethanol-resistant, but is susceptible to methylated spirit, which will attack the surface (due to one of the de-naturing substances).

Cleaning the front and rear panels and the c.r.t.'s contrast plate: do not use chemical solutions such as trichlorethylene or aceton.
Use a soft pad, cloth or cotton-wool with some water and common household cleansing or some alcohol or white spirit.

Check that after longer period of use, the holes in the cabinet plates don't get stopped up with dust. If necessary use pressurized air to free the holes.

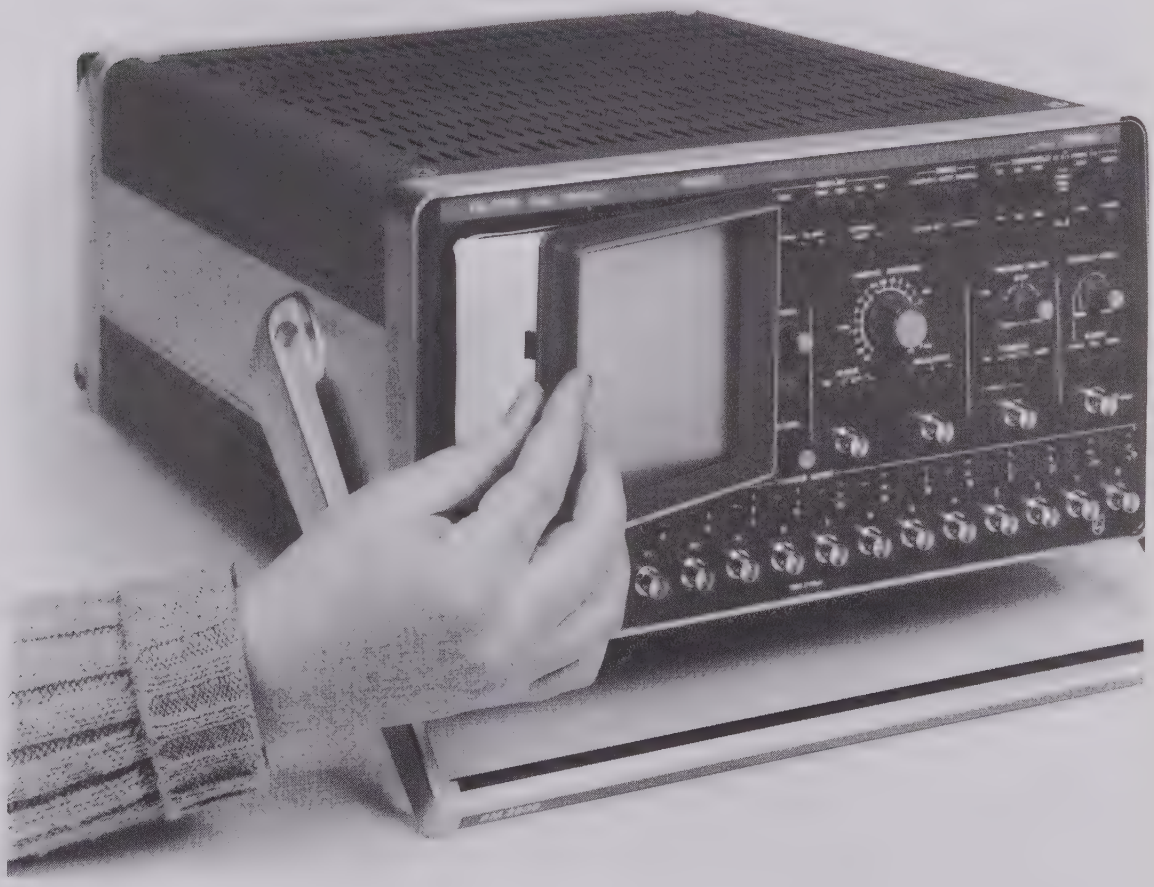


Fig. 2.4. Removing the c.r.t.'s bezel

PHILIPS

LOGIC PROBE
LOGIK TASTKOPF
SONDE LOGIQUE

PM8800

(9499 088 000111)

Introduction

The PM 8800 is a set of 4 logic probes, designed for use with the PHILIPS PM 3500 logic analyzer.

These probes can also be used with logic test equipment, having the same input specifications as the PM 3500.

Specification

Unless otherwise stated, the specifications listed apply to the logic probe only; i.e. excluding the effects of the PM 3500, or any other instrument used with the logic probe.
The properties expressed in numerical values with tolerances stated, are guaranteed by the manufacturer.
Numerical values without tolerances are typical and represent the characteristics of an average PM 8800.

CHARACTERISTIC (each probe)	*SPECIFIED PERFORMANCE*	*ADDITIONAL INFORMATION*
MAXIMUM RATINGS		
Input voltage (a.c. components ≤50 kHz)	250 V (d.c. + a.c. peak)	Probe-output terminated with 1 MΩ paralleled by ⩾ 10 pF
For derating of a.c. component at f >50 kHz	See Fig. 3.	Voltage applied between probetip and metal part of probe body
ATTENUATION (d.c.)	5x (±2 %)	Probe-output terminated with 1 MΩ
INPUT IMPEDANCE		Probe-output terminated with PM 3500 input
Resistance (Rp) a.c. to 50 kHz	5 MΩ ±100 kΩ	
Capacitance (Cp) d.c. to 50 kHz	13,5 pF ±0,5 pF	
Impedance (Xp) f >10 kHz	See Fig. 2.	
RISE TIME t_r	≤2 ns	Probe only. Probe-output terminated with PM 3500 input. t_r measured at PM 3500 input between 10 % and 90 % levels of transient response. Test voltage applied between probetip and metal part of probe body by means of a probe-to-connector adaptor
PROPAGATION DELAY	6 ns ±1 ns	Probe-output terminated with PM 3500 input. Measured between 50 % points of input signal, (applied between probe-tip and metal part of probe body by means of a probe-to-connector adaptor) and output signal (at PM 3500 input)

DIMENSIONS	L	W or diameter	BNC connector excluded
Probe body	96 mm	Ø : 5,5 to 9,2 mm	
Probe cable	1,5 m	3,5 mm	
Pouch	250 mm	180 mm	
MASS	230 g		PM 8800 complete in pouch.
Each probe	60 g		Test hook, pin-adaptor, probe ground wire and 2 markerrings included.

ENVIRONMENTAL DATA

The environmental data are valid only if the instrument is checked in accordance with the official checking procedure. Details on these procedures and failure criteria are supplied on request by the PHILIPS organisation in your country, or by N.V. PHILIPS' GLOEILAMPENFABRIEKEN, TEST AND MEASURING DEPARTMENT, EINDHOVEN, THE NETHERLANDS.

AMBIENT TEMPERATURE		Testprocedure in accordance with: IEC 68, Ab and Bb
Rated range of use	–25 °C to 70 °C	
Storage and transport	–40 °C to 70 °C	
Recovery time	1 h	If temp of probe is raised from –40 °C to 20 °C at 60 % rel. humidity
HUMIDITY	Probes and accessories withstand 21 cycles of damp heat test: temp. 25 °C to 45 °C, rel. hum. 90 % to 100 %. Cycle duration: 24 h.	Test procedure in accordance with IEC 68 Db.
ALTITUDE		
Limit of range of operation	5000 m (47,5 kPa)	
Limit of range of transportation	15000 m (10 kPa)	
BUMP	Each item of PM 8800 withstands 1000 bumps (of 100 m/s^2, 1/2 sine, 6 ms duration) in each of 3 directions	Test procedure in accordance with IEC 68 Fc
VIBRATION	Each item of PM 8800 withstands (in each of 3 directions) 30 min. vibration of 10 - 150 Hz, 0,7 mm peak to peak ampl. or 50 m/□ S^2 acceleration, whichever is greater.	Test procedure in accordance with IEC 68 Eb

Composition of one PM 8800 and service codes

Quantity	Description	Service code	Item no Fig. 1.
4	Probe	–	–
4	Probe ground wire	5322 321 24921	1
1	Ground terminal block	5322 290 84054	2
1	Ground wire	5322 321 24922	3
4	Insulating cap for i.c. pins	5322 462 44318	4
4	Test hook	5322 395 84101	5
4	Pin adaptor	5322 263 54103	6
2	Markerring brown	5322 532 54447	7
2	Markerring red	5322 532 64223	7
2	Markerring orange	5322 532 54446	7
2	Markerring yellow	5322 532 54448	7
2	Markerring green	5322 532 54449	7
2	Markerring blue	5322 532 64225	7
2	Markerring violet	5322 532 54451	7
2	Markerring grey	5322 532 54445	7
2	Markerring white	5322 532 64224	7
4	Cable clip	5322 401 14277	8
1	Pouch	–	–
1	Manual	–	–
(9)	Set of pin connection wires	5322 310 34111	–

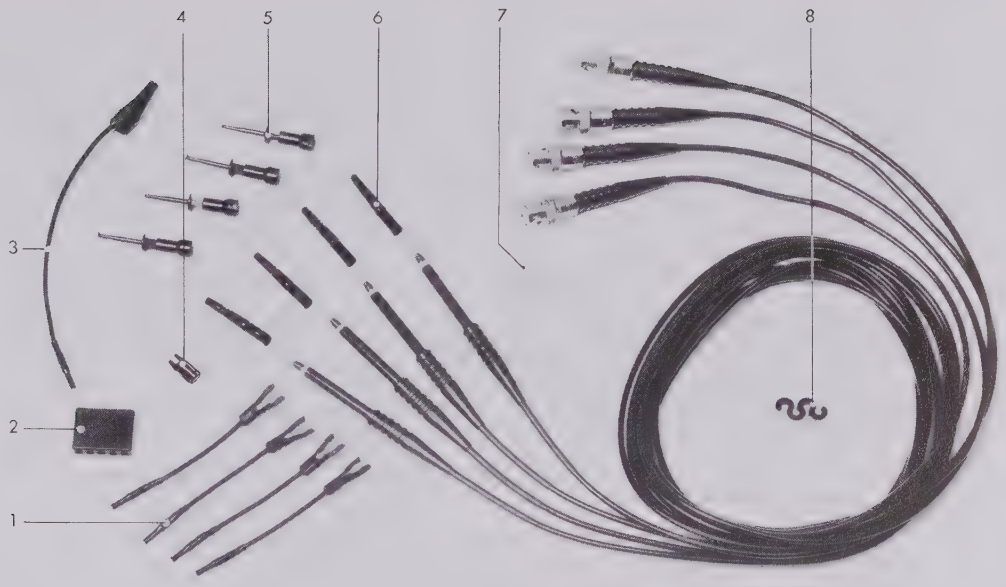


Fig. 1 Service parts PM 8800

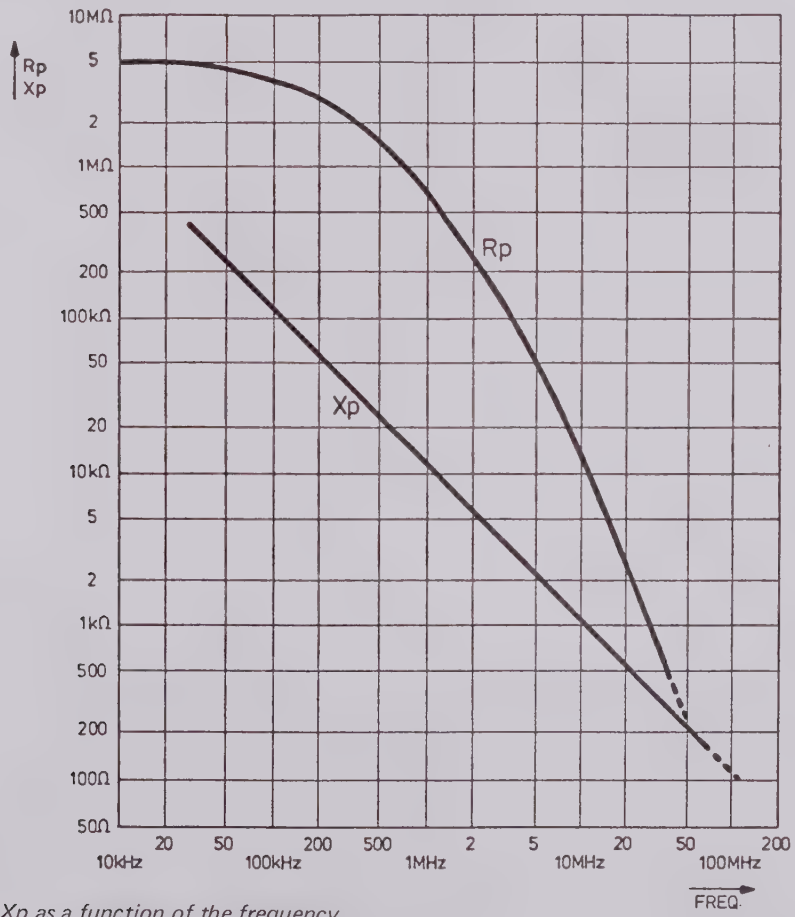


Fig. 2 Rp & Xp as a function of the frequency

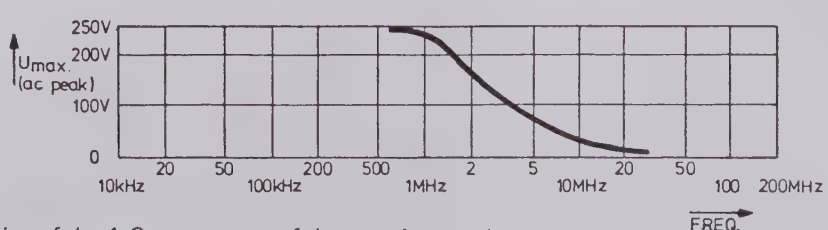


Fig. 3. Derating of the A.C. component of the max. input voltage

Einleitung

Der PM 8800 ist ein Satz von 4 Logik-Tastköpfen, vorgesehen für Anwendung mit dem PHILIPS PM 3500 Logik Analysator.

Diese Tastköpfe können auch mit Logik-Testgeräten, welche die gleichen Eingangskenndaten besitzen wie das PM 3500, verwendet werden.

Kenndaten

Falls nicht anders angegeben, gelten nachstehende Kenngrössen nur für PM 8800; d.h. ausschliesslich der Einwirkungen des PM 3500 oder eines anderen mit dem Logik Tastkopf verwendeten Geräte.
Zahlenwerte mit Toleranzangaben werden vom Hersteller garantiert.
Zahlenwerte ohne Toleranzangaben sind Durchschnittswerte eines PM 8800.

BEZEICHNUNG (jeder Messkopf)	*BESCHREIBUNG*	*NÄHERE ANGABEN*
MAXIMAL ZULÄSSIGE EINGANGSSPANNUNG		
(Wechselspannungs-komponenten $\leqslant$ 50 kHz)	250 V (DC + AC Spitze)	Tastkopfausgang abgeschlossen mit 1 MΩ parallel zu $\geqslant$ 10 pF
Zur Lastminderung der Wechselspannungs-komponente bei f >50 kHz)	Siehe Abb. 3	Spannung angelegt zwischen Tastkopfspitze und Metallteil des Tastkopfkörpers
ABSCHWÄCHUNG (DC)	5x (± 2 %)	Tastkopfausgang abgeschlossen mit 1 MΩ
EINGANGSIMPEDANZ		Tastkopfausgang abgeschlossen mit PM 3500 Eingang
Widerstand (Rp) AC bis 50 kHz	5 MΩ ± 100 kΩ	
Kapazität (Cp) DC bis 50 kHz	13,5 pF ± 0,5 pF	
Impedanz (Xp) bei f> 10 kHz	Siehe Abb. 2	
ANSTIEGSZEIT t_r	$\geqslant$ 2 ns	Nur Tastkopf. Tastkopfausgang abgeschlossen mit PM 3500 Eingang. t_r gemessen zwischen 10 % und 90 % Pegel der Signalflanke am PM 3500 Eingang. Testspannung angelegt zwischen Tastkopfspitze und Metallteil des Tastkopfkörpers mit Hilfe eines Tastkopf-Steckverbindung Adapters
FORTPFLANZUNGS-VERZÖGERUNG	6 ns ± 1 ns	Tastkopfausgang abgeschlossen mit PM 3500 Eingang. Gemessen zwischen 50 % Punkten des Eingangssignals (angelegt zwischen Tastkopfkörpers mit Hilfe eines Tastkopf-Steckverbindung Adapters) und dem Ausgangssignal (am PM 3500 Eingang)

ABMESSUNGEN	Länge	Breite oder Durchm.	(Ohne BNC-Stecker)
Tastkopfkörper	96 mm	Ø: 5,5 bis 9,2 mm	
Tastkopfkabel	1,5 m	3,5 mm	
Beutel	250 mm	180 mm	
MASSE	230 g		PM 8800 komplett in Beutel
Jeder einzelne Tastkopf	60 g		Einschliesslich Testhaken, Stiftkontakt-zwischenstück, Tastkopferdkabel und zwei Markierringen.

Einflussgrossen

Die angegebenen Daten gelten nur dann, wenn das Gerät gemäss den offiziellen Prüfverfahren kontrolliert wurde.
Einzelheiten diese Verfahren und Fehlergrenzkriterien betreffend können von der PHILIPS-Organisation Ihres Landes oder von N.V. PHILIPS' GLOEILAMPENFABRIEKEN, TEST AND MEASURING DEPARTMENT, THE NETHERLANDS angefordert werden.

UMGEBUNGSTEMPERATUR		
Nominaler Betriebsbereich	–25 °C ... +70 °C	Prüfverfahren den IEC 68, Ab en Bb Bedingungen entsprechend
Lagerung und Transport	–40 °C ... +60 °C	
Erholungszeit	1 Stunde	Wenn die Temperatur des Tastkopfs von –40 °C auf +20 °C erhöht wird, bei 60 % relativer Luftfeuchtigkeit
FEUCHTIGKEIT	Tastköpfe und Zubehören widerstehen 21 Zyklen einer Feuchtwärmeprüfung: Temp. + 25 °C bis +45 °, rel. Luftfeuchte 90 % ... 100 % Zyklusdauer: 24 Stunden	Prüfverfahren entspricht den IEC 68 Db Bedingungen
HÖHE		
Betriebsgrenzbereich	5000 m (47,5 kPa)	
Transportgrenzbereich	15000 m (10 kPa)	
STOSSFESTIGKEIT	Jedes Teil des PM 8800 widersteht 1000 Stössen (von 100 m/s^2, 1/2 Sinus, Dauer 6 ms), in jeder der 3 Richtungen	Prüfverfahren entspricht den IEC 68 Fc Bedingungen
VIBRATION	Jedes Teil des PM 8800 widersteht (in jeder der 3 Richtungen) 30 Minuten Vibrationen von 10 - 150 Hz 0,7 mm Spitze-Spitze Ampl. oder 50 m/s^2 Beschleunigung, wobei der höhere Wert gilt.	Prüfverfahren entspricht den IEC 68 Eb Bedingungen

Zusammenstellung eines PM 8800 und Servicecode

Menge	Bezeichnung	Servicecode	Pos. Nr. Abb. 1
4	Tastkopf	–	–
4	Tastkopferdkabel	5322 321 24921	1
1	Erdanschlussblock	5322 290 84054	2
1	Erdkabel	5322 321 24922	3
4	Isolierkappe für IC-Stifte	5322 462 44318	4
4	Testhaken	5322 395 84101	5
4	Stiftkontakt-Zwischenstuck	5322 263 54103	6
2	Markierring braun	5322 532 54447	7
2	Markierring rot	5322 532 64223	7
2	Markierring orange	5322 532 54446	7
2	Markierring gelb	5322 532 54448	7
2	Markierring grün	5322 532 54449	7
2	Markierring blau	5322 532 64225	7
2	Markierring violett	5322 532 54451	7
2	Markierung grau	5322 532 54445	7
2	Markierung weiss	5322 532 64224	7
4	Kabelklemme	5322 401 14277	8
1	Beutel	–	–
1	Anleitung	–	–
(9)	Satz Stiftkontakt-Drähte	5322 310 34111	–

Introduction

Le PM 8800 est un jeu de 4 sondes logiques développées à l'usage de l'analyseur logique PM 3500 de Philips.

Ces sondes peuvent servir d'accessoires à tout équipement de test logique ayant les mêmes spécifications d'entrée de le PM 3500.

Spécifications

A moins qu'indiqué différemment, les spécifications s'appliquent uniquement à la sonde logique, excluant par exemple les effets du PM 3500 ou de tout autre appareil couplé à cette sonde.
Les propriétés exprimées en valeurs numériques avec indication de tolérance sont garanties par l'usine.
Les valeurs numériques sans tolérances sont typiques et représentent les caractéristiques d'un PM 8800 moyen.

CHARACTERISTIQUES (par sonde)	*SPECIFICATIONS*		*INFORMATIONS SUPPLEMENTAIRES*
VALEURS NOMINALES MAXI			
Tension d'entrée (composantes en alternatif ⩽ 50 kHz)	250 V (CC + CA crête)		Sortie de sonde terminée par 1 MΩ mise en parallèle à un condensateur ⩾ 10 pF
Pour déréglage de la composante en courant alternatif à une fréquence > 50 kHz	Voir fig. 3		Tension appliquée entre la pointe de sonde et la partie métallique du corps de sonde
ATTENUATION (en courant continu)	(5x ±2 %)		Sortie de sonde terminée par 1 MΩ
IMPEDANCE D'ENTREE			Sorte de sonde terminée par entrée PM 3500
Résistance (Rp) CA à 50 kHz	5 MΩ ± 100 kΩ		
Capacité (Cp) à 50 kHz	13,5 pF ± 0,5 pF		
Impédance (Xp) pour f> 10 kHz	Voir fig. 2		
TEMPS DE MONTEE t_r	⩽ 2 ns		Sonde seule Sortie de sonde terminée par entrée PM 3500. t_r mesuré à l'entrée PM 3500, entre les niveau 10 % et 90 %. La tension d'essai est appliquée entre la partie métaillique du corps de sonde à l'aide d'un adaptateur sonde-connecteur
RETARD DE PROPAGATION	6 ns ± 1 ns		Sortie de sonde terminée par entrée PM 3500. Mesuré entre les points 50 % du signal d'entrée (application entre pointe de sonde et partie métaillique du corps de sonde à l'aide d'un adaptateur sonde-connecteur) et du signal de sortie (à l'entrée PM 3500)
DIMENSIONS	L	largeur ou Ø	
Corps de sonde	96 mm	Ø : 5,5 à 9,2 mm	(Connecteur BNC non compris)
Câble de sonde	1,5 m	3,5 mm	
Trousse	250 mm	180 mm	
MASSE	230 g		PM 8800 complet dans la trousse Grippe-fil, adaptateur pour broche de connexion, fille de terre de la sonde et 2 bagues d'identification compris.
Par sonde	60 g		

Conditions d'environnement

Les données d'environnement ne s'appliquent que lorsque l'appareil est contrôlé conformément aux processus officiels. Pour plus de dètails sur ces processus et les critères de panne, s'adresser à l'organisation PHILIPS locale ou à N.V. PHILIPS' GLOEILAMPENFABRIEKEN, TEST AND MEASURING DEPARTMENT, EINDHOVEN, PAYS-BAS.

TEMPERATURE AMBIANTE		Test conforme aux normes CEI 68, Ab et Bb
Gamme nominale d'utilisation	–25 °C à +70 °C	
Gamme d'emmagasinage et de transport	–40 °C à +70 °C	
Temps de rétablissement	1 h	Si la température de la sonde est accrue de –40 °C à +20 °C à 60 % d'humidité relative
HUMIDITE	Sondes et accessoires résistent à 21 cycles de chaleur humide, temp. 25 °C à 45 °C, hum. rel. 90 à 100 %. Durée du cycles: 24 heures	Test conforme à la norme CEI 68 Db
ALTITUDE		
Limite en fonctionnement	5000 m (47,5 kPa)	
Limite de transport	15000 m (10 kPa)	
CHOCS	Chaque PM 8800 résiste à 1000 chocs à accélération 100 m/s^2, 1/2 sinusoïde de 6 ms dans chacune des trois directions	Test conforme à la norme CEI 68 Fc
VIBRATIONS	Chaque PM 8800 résiste à 30 min. de vibration dans chacune des trois directions 10 à 150 Hz, 0,7 mm_{cc} ou accélération maximale de 50 m/s^2, la plus grande valeur prime.	Test conforme à la norme CEI 68 Eb

Composition d'un PM 8800 et codes de service

Quantité	Description	Code de service	Code repère fig. 1
4	Sonde	–	–
4	Fil de terre de la sonde	5322 321 24921	1
1	Bloque de borne de terre	5322 290 84054	2
1	Fil de masse	5322 321 24922	3
4	Capuchon isolant pour borne de circuit intégré	5322 462 44318	4
4	Grippe-fil	5322 395 84101	5
4	Adaptateur pour broche de connexion	5322 263 54103	6
2	Bague d'identification brune	5322 532 54447	7
2	Bague d'identification rpuge	5322 532 64223	7
2	Bague d'identification orange	5322 532 54446	7
2	Bague d'identification jaune	5322 532 54448	7
2	Bague d'identification verte	5322 532 54449	7
2	Bague d'identification bleue	5322 532 64225	7
2	Bague d'identification violette	5322 532 54451	7
2	Bague d'identification grise	5322 532 54445	7
2	Bague d'identification blanche	5322 532 64224	7
4	Pince-câbles	5322 401 14277	8
1	Trousse	–	–
1	Notice	–	–
(9)	Jeu de fils pour broche de connexion	5322 310 34111	–

Gebrauchsanleitung

1. EINLEITUNG

Der PM 3500 Logikanalysator ist ein äusserst vielseitiges Gerät, besonders geeignet für die Untersuchung komplexer Datenströme oder Signale in Digitalsystemen.
Die Eingangssignale werden im eingebauten 504 Worte, 16 Bits Speicher gespeichert.

Das Gerät arbeitet entweder mit einem externen Takt (gewöhnlich angewandt bei der Prüfung von Datenströmen, Programmabläufen und ähnlichem) oder mit internem Takt (ermöglicht eine detaillierte Prüfung von Timingproblemen, Zeitverhalten, Nachschwingen, Reflexionen usw.).
Der Takt lässt sich mit einem Qualifizierer kombinieren.

Die Festhalte (capture) Betriebsart ist eine Einrichtung welche die Erfassung von Störspitzen (Glitches), die zwischen zwei Taktflanken erscheinen, gestattet.

Drei wählbare Anzeigearten:

- Zeitdiagram Darstellungsart.
  Die Logiksignale werden als Kurvenzug dargestellt.
- Tabellarische Darstellungsart.
  Die Logiksignale werden als Worte dargestellt (hexadezimale, oktale oder binäre Anzeige wählbar).
- Map Darstellung.
  Der Wert eines jeden Eingangswortes wird in einen bestimmten Wert für die X- und Y-Koordinaten umgewandelt.
  So wird jedem verschiedenen Wort ein Punkt auf dem Bildschirm zugeordnet.

Eine weitere vorteilhafte Einrichtung ist die Vergleichsdarstellung (Compare Mode), die den Vergleich einer Datensuch-Tabelle mit einer zuvor gespeicherten Referenztabelle erlaubt.
Beim Suchbetrieb (SEARCH) wird die Vergleichsfunktion automatisch vorgenommen, so dass eine kontinuierlich erneuerte Datensuch-Tabelle mit der Referenz-Tabelle verglichen wird.

Triggerung (von der die Datenaufnahme gestoppt wird) kann erfolgen:

- Intern, das Triggerwort ist mit Hilfe der 16 Kippschalter, die sich direkt über den Eingangssteckverbindungen befinden, wählbar.
  Kombination mit einem Qualifizierer ist möglich.
- Extern, wählbar an einer positiv oder negativ gehenden Flanke eines externen Signals.
- Manuell, Drucktasten-Bestätigung

Start (startet die Datenaufnahme) kann erfolgen:

- Automatisch.
  Wiederholtes Starten der Datenaufnahme.
  Die Zeit zwischen zwei einander folgenden Startvorgängen lässt sich mit dem DISPLAY TIME Knopf einstellen.
- Extern.
  Mit einem TTL-Signal.
- Manuell, Drucktasten-Betätigung.

Die Logik-Pegel der Eingangskanäle sind in zwei Gruppen von jeweils 8 Kanäle wählbar. (–9 V ... +9 V).
Diese Werte gelten nur bei Anwendung der zugehörigen Tastköpfe.

1.1. TECHNISCHE DATEN

Dieses Gerät ist gemäss IEC 348, Klasse I, Sicherheitsbestimmungen für elektrische Mess- und Regeleinrichtungen, gebaut und geprüft und hat das Werk in sicherheitstechnisch einwandfreiem Zustand verlassen. Um diesen Zustand zu erhalten und einen gefahrlosen Betrieb sicherzustellen, muss der Anwender die Hinweise und Warnvermerke beachten, die in der vorliegenden Anleitung enthalten sind.

Die hier angegebenen Kenngrössen gelten nach einer Anwärmzeit von 15 Minuten. Zahlenwerte mit Toleranzangaben werden vom Hersteller garantiert, falls nicht anders angegeben. Zahlenwerte ohne Toleranzangaben sind Durchschnitswerte und dienen nur zur Information.

Eingangsdaten für Daten, Takt, Trigger und Qualifizierer gelten nur für Anwendung mit den zugehörigen Tastköpfen PM 8800.

Dateneingang

Anzahl	:	16 Kanäle
Impedanz	:	5M Ohm/13,5 pF
Max. Spannung	:	–250 V ... +250 V
Logik-Pegel	:	Kanäle 0-7 und 8-15 unabhängig von einander einstellbar Drucktastenwahl von TTL, ECL und variablem Pegel TTL +1,4 V ($\leqslant$ 0,8 V = "0" $\geqslant$ 2 V = "1") ECL –1,3 V ($\leqslant$ –1,63 V = "0" $\geqslant$ –1,065 V = "1") VAR –9 V ... +9 V stufenlos einstellbar
Max. Empfindlichkeit	:	Minimaler Signalsprung 500 mV_{s-s} Signalmitte an Schwelle für Registrierung bei 50 MHz. Siehe Abb. 1.1.
Vorbereitungs- und Haltezeit	:	Vorbereitungszeit ≈ 1 ns, Haltezeit ≈ 2 ns bezogen auf intern wirksame Taktflanke. Siehe Abb. 1.2.
Impulsbreite	:	Sample Betrieb: Einen Abtastinterval +3 ns. Capture Betrieb: $\geqslant$ 3 ns mit einer Signalsprung von 400 mV.
Skew (Laufzeitunterschied)	:	Kanal-zu-Kanal Skew weniger als 2 ns.

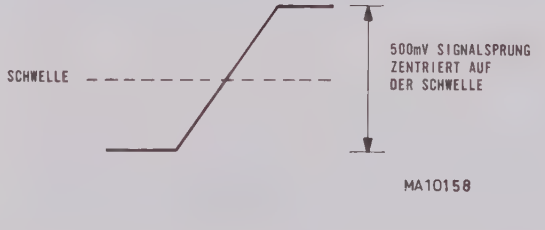


Abb. 1.1. Minimaler Signalsprung

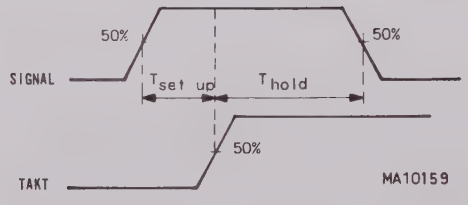


Abb. 1.2. Vorbereitungs- und Haltezeit

Takt

Quelle	:	Interner oder externer Takt wählbar.
Interner Takt	:	Quarzgesteuert. Frontplatteneinstellung 20 ms ... 10 ns. Abtastintervall mit einem 20-Stellungs Drehschalter in 1-2-5 Folge.
Externer Takt	:	Eingang über PM 8800 Tastkopf zur BNC-Buchse auf der Frontplatte. Max. Taktfrequenz 60 MHz. Falls die Taktfrequenz geringer ist als 50 Hz, er- scheint die Information NOS/SLOW CLOCK; die Analyzer-Funktionen bleiben jedoch wirksam. Minimale Taktpulsbreite 5 ns. Pegeleinstellung erfolgt zusammen mit den Kanälen 0 ... 7. Abtastung an positiv oder negativ gehender Taktflanke ist wählbar. Verzögerung zwischen externem Takteingang und Dateneingang = 15 ns, typisch.
Taktqualifizierer	:	Eingang über BNC-Buchse an der Frontplatte. Die Spezifikationen entsprechen denen für den Dateneingang. Pegel wie Kanäle 0 ... 7. Ab Ausführung -/03 kann die Schwelle auch für TTL eingestellt werden, unabhänging von Kanal 0 ... 7. Abtastung erfolgt nur wenn der Qualifizierer an der Taktflanke "wahr" (true) ist. "Wahr" ist für "1" oder "0" Pegel wählbar. In Stellung "X" "don't care", ist der Qualifizierer abgeschaltet. Vorbereitungszeit = 4 ns, Haltezeit = 3 ns, bezogen auf die tatsächliche Taktflanke an der Tastkopfspitze.

Trigger

Quelle	:	Intern, extern oder manuell wählbar.
Triggerung	:	Im Abtastbetrieb (Sampling) auf Signale mit einer Impuls- breite von einem Abtastintervall +3 ns. Im Festhaltebetrieb: Triggerung auf Spannungsspitzen $\geqslant$ 3 ns.
Intern	:	Triggerwort - Erkennung auf 16 Kanäle und Trigger- quallifizierer. Die Kombination des Triggerworts wird von 16 Schaltern mit den Stellungen "1", "0" und "X" (don't care) definiert. Triggerung erfolgt bei einer Übereinstimmung zwischen einem Eingangsdatenwort und einer gewählten Kombination.
Extern	:	Eingang über BNC-Buchsen auf der Frontplatte Spezifikation entspricht den Dateneingängen. Pegel wie Kanal 0 ... 7. Ab Ausführung -/03 kann die Schwelle auch für TTL eingestellt werden, unabhänging von Kanal 0 ... 7. Triggerung an positiv oder negativ gehender Flanke des Triggersignals wählbar.
Manuell:	:	Triggerung über Frontplatten-Drucktasten. ⟨⟨
Triggerqualifizierer	:	Spezifikationen wie externer Triggereingang jedoch kombiniert mit interner Triggerwahl ("INT") angewandt. Das Triggerwort wird von Triggerqualifizierer "wahr" konditioniert. "Wahr" ist für "1", "0" und "X" (abgeschaltet) wählbar.

Triggerverzögerung	:	Der Trigger kann um 0 ... 9999 Taktimpulse, eingestellt mit einem kontinierlich einstellbarem Zähler, verzögert werden. Verzögerter Aufzeichnungsbetrieb wie center, pre- und post-Triggerung kann mit Hilfe dieses einzigen Einstellelements genauestens ausgeführt werden.

START

Quelle	:	Automatisch, extern und manuell wählbar.
Automatisch	:	Das Gerät startet automatisch in einer Frequenz, die von der Darstellungszeiteinstellung von etwa 1 bis 10 Sekunden (±20 %) abhängig ist.
Extern	:	Start-Abfrage kann von einem an BNC-Eingang auf der Frontplatte gelegten externen Impuls erfolgen. TTL-Pegel "0" wâhrend ⩾ 40 ms.
Manuell	:	Start erfolgt durch Betätigung der Frontplatten-Drucktaste.
SPEICHER	:	Das Speicherformat ist 504 Worte. Im Vergleichsbetrieb (COMPare Mode) wird der Analysator in zwei Einheiten von je 248 Worten geteilt. Ein Wort besteht aus 16 Bits.

BETRIEBSARTEN

Abtastbetrieb (SAMPLE)	:	Die Eingangssignale werden gleichzeitig an den Abtast-taktflanken in den Speicher eingetaktet bezogen auf den gewählten Pegel. Die registrierte Impulsbreite ist ein Abtastintervall +3 ns mit 250 mV oder grössere Pegel überschreitung.
Festhaltebetrieb (CAPture)	:	Schmale Störspitzen (Glitches) kürzer als ein Abtastintervall, mindestens aber 3 ns mit einer Pegelüberschreitung von 400 mV (4ns mit einer Pegelüberschreitung von 250 mV). Die registrierte Störspitze wird bis zur nächsten Taktflanke gespeichert und während eines Abtastintervalls dargestellt.
Vergleichsbetrieb (COMP)	:	Die Hälfte des Speichers ist für die Speicherung von Referenz-daten reserviert. Bei der Tabellen-Darstellung werden sowohl Suchtabellen wie Referenztabellen dargestellt. Nichtübereinstimmung innerhalb der 248 Worte registrierter Daten wird in den Textzeile mit der Information "UNEQ" und in der Tabelle mit aufgehellten Digits angezeigt.
Referenzspeicher (STORE REF)	:	Die Referenzdaten werden erfasst, gespeichert und dargestellt. Referenzdaten werden bis zur Rücksetzung des Vergleichs-betriebs gespeichert.
Suchbetrieb (SEARCH)	:	Daten werden automatisch, durchlaufend im 248-Worte Such-Tabellenspeicher erfasst und mit den gespeicherten Referenzdaten verglichen. Wenn eine Nichtübereinstimmung auftritt, stoppt die Daten-erfassung und die zu den zuletzt registrierten Daten gehörige Tabelle wird zusammen mit den Referenzdaten dargestellt. Nichtübereinstimmung wird aufgehellt. Die erste Zeile der Anzeige (Cursor) weist die erstgefundene Nichtübereinstimmung an. Die Anzahl der Suchvorgange wird gezählt und in den Textzeile angegeben.

ANZEIGE

Röhre		: Philips D18 - 120 GH
Schirmtyp		: P37 (GH) 10 x 12 cm 10 kV Röhre mit elektrostatischer Ablenkung. Fokus- und Helligkeitseinstellung auf der Frontplatte. Im oberen Teil des Bildschirms wird eine Textzeile, die den Zustand des Geräts und wesentliche Parameter angibt, dargestellt.
Bildverdrehung		: Inwendig einstellbar.
Cursor		: Der Cursor (elektronischer Zeiger) dient als Referenz in den registrierten Daten und wird mit Hilfe von drei Drucktasten verschoben; zwei zur Bestimmung der Richtung in Inkrementen eines Abtastintervalls und eine für Schnellbetrieb. Der Cursor besteht aus 16 Worten. Das erste Wort ist dat eigentliche Cursorwort, dargestellt in der Textzeile, zusammen mit seiner Zeilennummer für Positionierzwecke. Die Zeilennummer ist der relative Abstand (in Abtastschritten jedes Worts) zum Triggerwort.
Darstellungsarten		: Timing, Tabellierung und Mapping.
	Time (Zeitdarstellung)	: 16 Kanäle angeordnet in 4 Gruppen. von 4 horizontalen Zeitdiagrammen.
	Expand (gedehnt)	: Zeitachse ist mit Hilfe einer Drucktaste um das 10-fache und 25-fache dehnbar. Die Position des Cursors dient als Startwert in den gedehnten Zeitdarstellungen.
	Tabellendarstellung	: Wahl der binären, hexadezimalen oder oktalen Zustandstabellen. Der 16-Wort-Cursor wird in Form einer Tabelle dargestellt. Alle Worte werden durch eine Nummerierung relativ zu ihrer Position zu dem Triggerwort gekennzeichnet.
	Mapping	: Jedes Wort wird, durch Darstellung der Worthälfte niedriger Ordnung entlang der Horizontalen und der Worthälfte höherer Ordnung entlang der Vertikalen, von einem ihm zugeordneten Punkt repräsentiert. Der Cursor wird von einem "0" Symbol angezeigt und wird in der Textzeile ausgegeben. Die Helligkeit der Punkte zeigt die Ereignisfrequenz innerhalb der registrierten Daten an.
Blank (Unterdrücken)		: Einzelne Kanäle lassen sich durch Drücken der Taste BLANK "+" beginnend mit Kanal 15 nacheinander unterdrücken. Rückstellung erfolgt mit Hilfe der BLANK-Taste "—". Im Zeitdiagram - (TIME) Betrieb werden die übrigen Kanäle in Gruppen von jeweils vier kanälen über die gesamte Anzeige neugruppiert. In der Tabellendarstellung führt Löschung zu Unterdrückung der Spalten von links (Kanal 15) nach rechts (Kanal 0). Bei Darstellungsart MAP bedeutet die Löschung eine Reduzierung der Darstellung in Stufen von 8 x 8 bit, 7 x 8 Bit, 7 x 7 Bit usw. Da der gesamte Bildschirm benutzt wird erhält man eine gedehnte Mapping-Darstellung.

AUSGÄNGE

Über BNC-Buchsen an der Geräterückseite.

Startausgang	:	TTL-Pegel, 0-1 Übergang beim Startmoment nach interner Aufbauzeit.
Triggerausgang	:	ECL-Pegel, 0-1 Übergang beim Triggermoment.

Siehe auch Abb. 2.3.6.

STROMVERSORGUNG

Leistungsaufnahme	:	110 W 160 VA
Netzspannungen und Frequenzen	:	110 - 127 V AC ±10 % 220 - 240 V AC ±10 % 48 - 440 Hz Netzsicherungen 3,15 A träge (2x) für beide Netzspannungsbereiche.
Sicherheitsbedingungen	:	IEC 348, Klasse I Normen entsprechend.

EINFLUSSGROSSEN

Die angegebenen Daten gelten nur dann, wenn das Gerät den offiziellen Prüfverfahren entsprechen kontrolliert wurde. Einzelheiten dieses Verfahren und die Fehlergrenzkriterien betreffend, können von der PHILIPS-Organisation Ihres Landes oder von N.V. PHILIPS' GLOEILAMPENFABRIEKEN, TEST AND MEASURING DEPT., EINDHOVEN, NIEDERLANDE angefordert werden.

Umgebungstemperatur	:	–10 °C ... +40 °C., Betrieb –40 °C ... +70 °C., Lagerung und Transport
Feuchtigkeit	:	21 Tage zyklisch, feuchte Wärme +25 °C ... +40 °C, relative Luftfeuchte 95 %
Stossfestigkeit	:	30 g; ½ Sinus-Stoss, Dauer 11 ms. 3 Stösse je Richtung, insgesamt 12 Stösse.
Vibration	:	3 g Vibrationen in drei Richtungen, maximal 15 Minuten pro Richtung. 10 Minuten mit einer Frequenz von 15 ... 25 Hz und einer Amplitude von 1 mm Spitze-Spitze. 5 Minuten mit einer Frequenz von 25 ... 55 Hz und einer Amplitude von 0,5 mm Spitze-Spitze.

ABMESSUNGEN UND GEWICHT

Höhe	:	200 mm
Breite	:	386 mm
Tiefe	:	470 mm
Gewicht	:	14 kg

MITGELIEFERTE ZUBEHÖREN

- Fünf PM 8800 Testkopfsätze, jeder Satz enthält 4 Logik Testköpfe.
- Bedienungs/Service Anleitung.

ZUSÄTZLICH LIEFERBAR

- Trigger tastkopf PM 8810.

2. GEBRAUCHSANLEITUNG

2.1. BEDIENUNGSELEMENTE

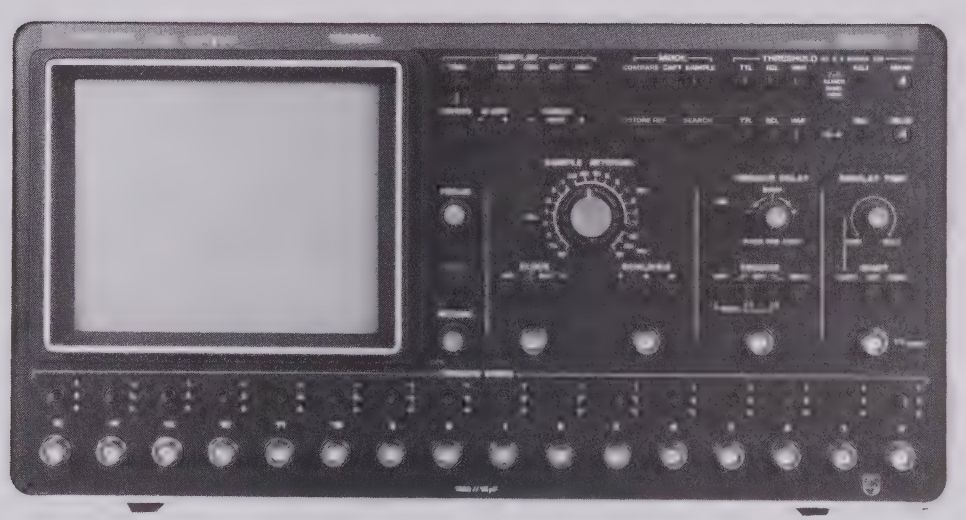


Abb. 2.1. Vorderansicht

ELEKTRONENSTRAHLROHRE

INTENS - OFF	:	Schalter mit kombinierter Funktion: Stromversorgung Ein-Aus und Bildhelligkeits-einstellung.
FOCUS	:	Fokussierung des Elektronenstrahls.
POWER ON	:	Signallampe des EIN/AUS - Zustands

ANZEIGE

TIME	:	Drucktaste wählt die Zeitdiagramm-Darstellungsart.
MAP	:	Drucktaste wählt die Mapping Darstellungsart.
HEX	:	Drucktaste wählt hexadezimale Zustandstabellierung. Der Inhalt des Cursors wird angezeigt.
OCT	:	Drucktaste wählt oktale Zustandstabellierung. Der Inhalt des Cursors wird angezeigt.
BIN	:	Drucktaste wählt binäre Zustandstabellierung. Der Inhalt des Cursors wird angezeigt.
EXPAND	:	Drucktaste gestattet der Reihe nach Zeitdehnung 1, 10 und 25.
BLANK	:	Zwei Drucktasten.

"+" : Daten-Kanäle werden, beginnend bei Kanal 15, unterdrückt solange diese Taste betätigt ist.

"–" : Diese unterdrückten Kanäle werden wieder dargestellt, jedoch in umgekehrter Richtung wie bei Taste "+".

CURSOR : Drei Drucktasten.

"–" : Der Cursor läuft nach links im Zeitdiagramm (TIME) - Betrieb und aufwärts im Tabellierungsbetrieb.

"+" : Der Cursor läuft nach rechts im Zeitdiagrammbetrieb und abwärts im Tabellierungsbetrieb.

FAST : Wenn eine der Richtungstasten zusammen mit Taste FAST betätigt wird, dann läuft der Cursor 15x schneller.

. Sowohl Einzelschritt wie (nach einer Verzögerung) kontinuierlicher Ablaub.
. Der Inhalt des Cursors ist 16 Worte.

BETRIEBSART

SAMPL : Drucktaste.
Bei Abtastung der Daten erfolgt mit gewähltem Taktintervall (intern) oder mit externem Taktgeber.

CAPT : Drucktaste.
In dieser Betriebsart können Störimpulse mit einer Mindestimpulsbreite von 3 ns, die zwischen Taktübergängen auftreten, registriert werden, sie werden während des folgenden Taktintervalls dargestellt.

COMP : Drucktaste.
. Der Speicher wird in zwei gleiche Teile von 248 Worten zerlegt, wovon eine Hälfte zum Abspeichern einer Referenztabelle verwendet werden kann.
In der Anzeige erscheinen im Tabellierbetrieb zwei Tabellen mit einer Länge von 248 Worten.
Falls die Tabellen ungleich sind, werden die fehlerhaften Bits in in der Suchtabelle aufgehellt.

Im Vergleichsbetrieb sind nachstehende Einstellelemente anwendbar:

STORE REF : Drucktaste.
Startet Registrierung zur Aufnahme in einen Referenzspeicher.

SEARCH : Drucktaste.
Startet automatisch Aufzeichnung die alle Daten auf die Referenztabelle bezieht.
Bei Nichtübereinstimmung von zumindest einem Bit stoppt die Aufzeichnung.

PEGEL

Die Pegeleinstellung umfasst folgende zwei gleiche Gruppen:

TTL : Drucktaste wählt eine Schwelle des Eingangskomparators um TTL-Logik Messungen an den 5:1 Tastkopfspitzen zu ermöglichen.

ECL : Drucktaste ermöglicht ECL-Logik Messungen an 5:1 Tastkopfspitze.

VAR : Drucktaste gestattet eine variable Schwelleneinstellung von –9 V bis +9 V an der 5:1 Tastkopfspitze.

ADJ : Schraubenziehereinstellung für variable Schwelle.

MEAS : Ausgang der eingestellten Spannung.

: Eine Grupper der Eingänge : – Kanal 7 - 0.
– Externer Taktgeber.
– Taktqualifizierer.
– Externe Trigger.

: Die andere Gruppe für Kanaleinstellung : – Kanal 15 - 8.

TAKT

INT : Drucktaste wählt internen Abtasttakt.

EXT : " ⌐ " Drucktaste wählt externen Takt für positiv gehende Flanke.

" ⌙ " Drucktaste wählt externen Takt für negativ gehende Flanke.

SAMPLE INTERVAL : 20-Stellunge Drehschalter in 1-2-5 Folge.
Abtastintervallwähler von 10 ns bis 20 ms für internen Takt.

Eingang: BNC-Buchse für externen Takt. 1 MOhm//15 pF, max. Spannung ± 50 V kontinuierlich.

Qualifizierer : Taktqualifizierer, für den Abtasttakt.
Drucktaste "1" : wählt "wahr" für einen HI-Pegel.
Drucktaste "0" : wählt "wahr" für einen LO-Pegel.
Drucktaste "X": Qualifizierer ist abgeschaltet.

Eingang: BNC-Buchse für Qualifizierer, 1 MOhm//15 pF, max. Spannung ± 50 V kontinuierlich.

INT : Drucktaste wählt interne Triggerung über eingestelltes Triggerwort.

EXT : " ⌐ " Drucktaste : externe Triggerung an positiv gehender Flanke.

" ⌙ " Drucktaste : externe Triggerung an negativ gehender Flanke.

MAN : Manuelles Stoppen der Registrierung.

TRIGGER DELAY : Drucktaste "ON" : Einstellung der Triggerverzögerung.
. Drehknopf "–STOP +" : Wählt die Triggerzögerung.
"+" zählt aufwärts bis 9999.
"–" zählt abwärts.
. Wenn der Drehknopf eingedrückt ist erfolgt die Zählung 100 mal schneller.

EINGANG : BNC-Buchse für externen Triggerimpuls. 1 MOhm//15 pF max, Spannung ± 50 V kontinuierlich.

START

AUTO : Drucktastenwahl für automatischen Start.

DISPLAY TIME : Knopf für die Einstellung der Darstellungszeit von 1 bis 10 Sek.

EXT : Drucktaste. Externer Start auf negativ gehenden TTL-Impuls über BNC Eingang.

MAN : Manuelle Start der Messungen.

Eingang: BNC-Buchse für externen Start. TTL-Pegel.

TRIGGERWORD

1-X-0 : 16 Dreiwegschalter erlauben dem Anwender die Wahl eines Triggerworts. Wenn zwischen Eingängen und gewähltem Triggerwort eine Übereinstimmung auftritt, liefert der Wort-Erkenner einen Triggerimpuls.

2.2. INBETRIEBNAHME

Allgemeines

Dieser Abschnitt erläutert die Verfahren und die erforderlichen Sicherheitsmassnahmen für die Inbetriebnahme des PM 3500 und erklärt die praktischen Aspekte der Betreibsweise.
Dieses Gerät entspricht den Sicherheitsbedingungen IEC 348 Klasse I Norm.

Netzeinstellung und Sicherung

Den hinter der Rückwand befindlichten Spannungsumschalter für den entsprechenden Speisespannungsbereich einstellen.
In den an der Geräterückwand befestigten beiden Sicherungshaltern, befinden sich 3,15 A, träge Sicherungen.
Zum Ersetzen dürfen nur Sicherungen des vorgeschrieben Type und Stromwerts verwendet werden.
Die Verwendung reparierter Sicherungen oder das Kurzschliessen der Sicherungshalter ist nicht zulässig.
Beim Ersetzen einer Sicherung muss das Gerät von allen Stromquellen getrennt sein.

Erdung

Vor Einschaltung muss das Gerät auf eine der folgenden Weisen mit einem Schutzerdeleiter verbunden werden.

- über die Schutzerdeklemme an der Rückwand (gekennzeichnet mit ⏚);
- über den Erleiter im dreiadrigen Netzkabel.

Der Netzstecker muss in eine Schutzkontaktsteckdose eingeführt werden.
Diese Sicherheitsmassnahme darf nicht durch Verwendung einer Verlängerungsleitung ohne Schutzleiter unwirksam gemacht werden.
Ersetzen des Netzstecker geschieht auf eigene Gefahr des Anwenders.

WARNUNG: Jede Unterbrechung des Schutzleiters innerhalb oder ausserhalb des Geräts oder Trennung der Schutzerdeklemme ist sicherheitsgefährend.

Inbetriebnahme

Vor jedem Anschluss muss die Schutzerdeklemme mit einem Schutzleiter verbunden werden (siehe Abschnitt "Erdung").

WARNUNG: Das öffnen von Abdeckungen oder der Ausbau von Bauteilen, ausser von solchen die von Hand zugänglich sind, kann stromführende Teile und zugängliche Anschlussklemmen freilegen und kann somit lebensgefährlich sein.

Vor Ausführung von Einstellungen, Ersetzen von Bauteilen, Wartung oder Reparaturen bei geöffneten Gerät, muss dieses von allen Stromquellen getrennt sein. Wenn danach eine Kalibrierung, Wartung oder Reparatur am geöffneten Gerät unter Spannung unvermeidlich ist, so darf das nur durch eine Fachkraft, die die damit verbundenen Gefahren kennt, geschehen. Es ist zu beachten das Kondensatoren im Gerät noch geladen sein können, selbst wenn dass von allen Spannungsquellen getrennt ist.

Kühlung

Die natürliche Luftzirkulation durch das Gerät, darf nicht behindert werden.
Keine Geräte oder Papiere auf das Gerät stellen oder legen, um übermässige Erwärmung zu verhindern.

Überlastschutz

Im Falle eines Überstroms in der Schaltung (möglich als Folge übermässig hoher Temperaturen) schaltet die eingebaute Speiseschaltung ab; die Lampe POWER erlischt. Das gleiche könnte geschehen wenn die Netzspannung mehrfach hintereinander unterbrochen wird.
In einem solchen Fall muss die Netzspannung mit Hilfe des Schalters POWER auf der Frontplatte ausgeschaltet werden. Das Gerät zumindest 5 Minuten abkühlen lassen und danach von neuem einschalten.

Tragbügel

Der Tragbügel lässt sich drehen wenn die Lagerzapfenknöpfe eingedrückt werden.

Einschalten

Der Netzschalter POWER ist gekoppelt mit der Einsteller INTENS.
Das Gerät darf niemals eingeschaltet werden, wenn eine Leiterplatte entfernt wurde.
Eine Leiterplatte darf nicht früher als eine Minute nach Ausschaltung des Gerätes entfernt werden.

Power ON Test (Einschalttest)

Bei Einschaltung löst der Mikroprozessor ein Testprogramm zur überprüfung der unmittelbaren Schaltekreisen des Mikroprozessors aus.

Service Test

Das Gerät ist mit einem Testprogramm ausgestattet, mit dessen Hilfe sich ein möglicher Funktionsfehler lokalisieren lässt.
Diese Testprogramm kann mit einem Schalter, der sich auf der Mikroprozessor-Leiterplatte befindet eingestellt werden.
Für nähere Einzelheiten siehe: Serviceteil dieser Anweisung.

Grund-Einstellung

Nachstehende Betriebsarten und Werte werden bei Einschaltung automatisch eingestellt:

- TIME (Zeitdiagramm)Betriebsart X1.
- Alle 16 kanäle eingeschaltet.
- Cursor an Speicheranfang.
- Triggerverzögerung 503 (wenn Taste ON gedrückt).

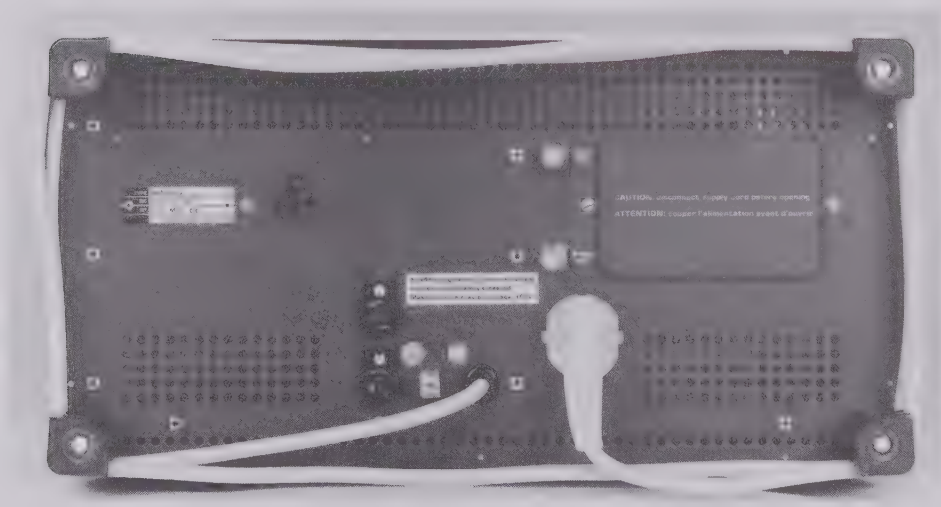


Abb. 2.2. Hintenansicht, Netzspannungswähler und Netzsicherungen

2.3. BETRIEB

Eingang

Die Signale, die dargestellt werden sollen, müssen über PM 8800 Tastköpfe an die Frontplatten-Eingänge 0 ... 15 gelegt werden. Falls nicht alle Eingänge benötigt werden, beginnend bei Eingang 0 anschliessen (Siehe auch Abschnitt "Kanal Löschung").
Einwandfreier Erdanschluss jedes Tastkopfes ist unbedingt zu beachten.

Eingangspegel

Für eine einwandfreie Ermittlung der Eingangssignalpegel ist eine korrekte Einstellung der Triggerschwelle erforderlich.
Dies geschieht automatisch für die TTL- oder ECL-Pegel: eine variable Schwelle (VAR) ist auch eingebaut.
Es ist zu beachten dass die Schwellwerte nur dann gelten wenn die Tastköpfe PM 8800 (mit einer Spannungsabschwächung von 1:5) angewandt werden.
Für die Einstellung des Schwellwerters in Betriebsart VAR ein Voltmeter an die Ausgangsklemme MEAS der betreffenden Eingangsgruppe anschliessen und das entsprechende Potentiometer einstellen (Schraubendreher Einstellung).
Beachte dass der SchwellwertE für die Eingänge 0 ... 7 und für die Eingänge 8 ... 15 gesondert eingestellt werden kann. Die für Eingänge 0 ... 7 eingestellten Schwellwerte gelten auch für die Eingänge: CLOCK, CLOCKQUALIFIER und TRIGGER.
Der Eingang EXT. START ist nur für TTL-Pegel geeignet.
Ab Ausführung -/03 kann der EXT TRIG/TRIG QUAL Eingang, und der CLOCK QUAL Eingang für TTL eingestellt werden, unabhänging von der Schnelleneinstellung der Kanäle 0 ... 7.
Dies geschickt mit Hilfe von Jumpers auf der Miktroprozessor - Platine wie Fig. 2.3.1. veranschaulicht.

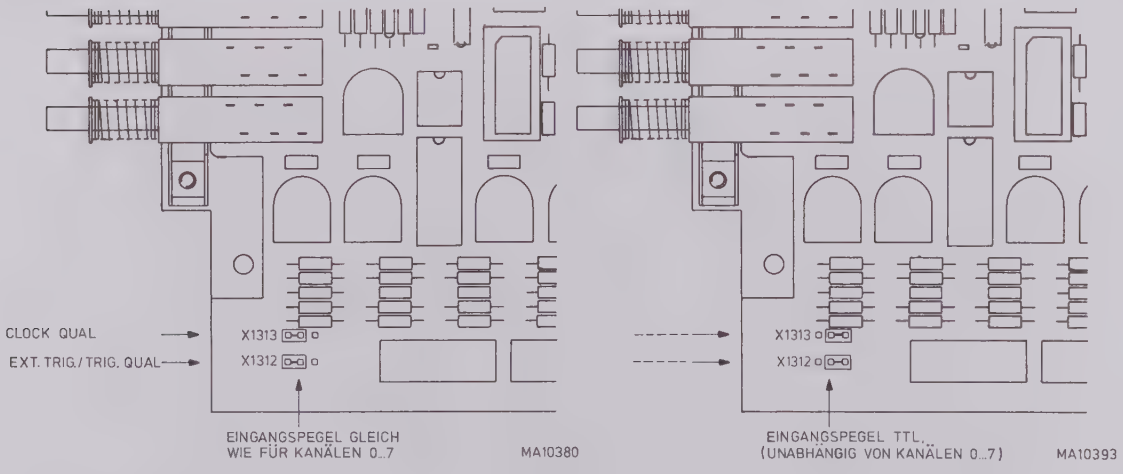


Abb. 2.3.1. Pegeleinstellung der EXT TRIG/TRIG QUAL Eingang und der CLOCK QUAL Eingang ab Ausführung -/03.

Takteingang

Der Takt ist ein wiederholtes Signal das die Frequenz der Abtastung der Eingangssignale regelt. Bei jedem Taktimpuls wird der Logikzustand des Eingangssignals im Speicher des PM 3500 gespeichert.
Obiger Vorgang wird von der START-Funktion ausgelöst und von der TRIG-Funktion beendet.

EXTerner Takt

Das Taktsignal kann dem im System das geprüft werden soll verhandenen Taktgenerator entnommen werden. In diesem Fall spricht man von einem synchronem Takt, weil der Abtastvorgang des Analysators mit dem Prüfling synchron läuft.
Der Taktvorgang kann an der positiv oder negativ gehenden Flanke des Systemtaktes gewählt werden.
Externer Taktbetrieb wird normalerweise bei Software-Problemen, wie Programmablaub und ähnlichem angewandt.
Die Parameter für den Anschluss des externen Takteingangs, entsprechen denen der Eingänge 0 ... 7.

INTerner Takt

Ein Vorteil des internen Takts liegt darin, dass im allgemeinen die Abtastungen des Systems, das geprüft werden soll, mit einer höheren Frequenz als der Systemakt erfolgt. Dies gestattet genauere Untersuchung von zeitbezogenen Problemen, Vergleich von Impulsflanken usw. Man nennt diese Betriebsart asynchroner Takt.
Die Intervalzeit ist mit Hilfe des Schalters SAMPLE INTERVAL einstellbar zwischen 20 ms und 10 ns (50 Hz bis 100 MHz), in Stufen von 1, 2 und 5.

Takt qualifizierer

Der Taktqualifizierer erlaubt eine mehr selektivere Datenerfassung, durch Konditionierung des Taktes mit einer zusätzlichen Bedingung, die "1", "0" oder "X" (don't care) sein kann. Wählbar mit den Tasten QUALIFIER 1, X oder 0.

Start

Die Startfunktion regelt den Zeitpunkt zu welchem die Daten-aufnahme des Analysators beginnt, und kann auf drei verschieden Arten ausgelöst werden:

- AUTOmatisch
- EXTern
- MANuell

Im automatischen Betrieb (Taste AUTO drücken) erfolgt erneute Daten-einnahme alle 1 ... 10 Sekunden, einstellbar mit Einstallknopf DISPLAY TIME.

Externer Start (Taste EXT drücken) wird von einem gesonderten, an den betreffende Eingang auf der Frontplatte gelegtem, negativ gehendem TTL-Signal ermöglicht.
Manueller Start wird durch Drücken der Taste MAN bewirkt.

Triggerung

Der Triggervorgang stoppt die Aufnahme von Daten, so dass der Inhalt des Datenspeichers stabil bleibt und auf dem Bildschirm dargestellt werden kann.
Als Triggerquelle kann gewählt werden: ein vorgewähltes im Eingangsdatenstrom vorkommendes Wort (interne Triggerung); ein extern eingespeistes Signal; oder manuell.

INTerne Triggerung

Triggerung erfolgt wenn eine bestimmte voreingestellte Bit-Kombination (Triggerwort) im Datenstrom erkannt wird (Taste INT drücken). Dieses Triggerwort besteht aus einer Kombination von "1" und "0" Logik-zuständen, gewählt mit Hilfe der Schalter die sich unmittelbar über den Dateneingangsbuchsen befinden.
Für nicht benutzt Kanäle oder für Kanäle mit belangloser Bitinformation Stellung X (don't care) des entsprechenden Schalters einstellen.
Interne Triggerung lässt sich mit Triggerverzögerung und Triggerqualifizierer kombinieren (siehe Abb. 2.3.2.).

EXTerne Triggerung

Triggerung erfolgt durch ein Externes Signal, wählbar für positiv oder negativ gehende Flanke, gelegt an den Triggereingang auf der Frontplatte (eine der beiden EXT Tasten drücken). Siehe Abb. 2.3.2.
Externe Triggerung lässt sich mit Triggerverzögerung kombinieren.

MANuelle Triggerung

Triggerung erfolgt durch Drücken der Taste MAN; dies ist allen anderen Triggerbedingungen übergeordnet (auch der Triggerverzögerung). Manuelle Triggerung ist geeignet zur Darstellung gespeichert Daten, selbst wenn das Triggerwort unbekannt oder unauffindbar ist.

Triggerverzögerung

Durch Drücken der ON Taste wird die Triggerverzögerung eingeschaltet. Die Triggerverzögerung ist eine Zahl von Taktimpulsen, die zwischen dem Eintreffen des Triggerworts oder eines externen Triggersignals und dem tatsächlichen Zeitpunkt der Triggerung eintreffen müssen. Siehe Abb. 2.3.3.
Bei Einschaltung wird die Triggerverzögerung automatisch auf 503 gestellt, dies besagt dass der gesamte Speicher mit unmittelbar nach dem Triggerwort (oder Triggersignal) eintreffenden Daten beschrieben wird.

Die Triggerverzögerung ist mit dem Potentiometer TRIG DELAY zwischen 0 und 9999 einstellbar (in Stellung STOP bleibt dieser Wert stabil) und wird in der Textzeile der Anzeige sichtbar.

Wenn die Triggerverzögerung ausgeschaltet wird (ON-Taste rückstellen) oder wenn die Triggerverzögerung auf 0 gestellt ist, erfolgt die Triggerung sobald das Triggerwort an den Dateneingängen vorhanden ist. In diesem Fall enthalt der Speicher Daten die unmittelbar vor dem Triggerwort (oder Triggersignal) eingetroffen sind.

Automatisches "paging" (Bildschirmblättern oder Ablesung in Blöcke geteilt), wird folgendermassen ermöglicht:

- Wähle die Startbetriebsart AUT mit einer Darstellungszeit von z.B. 5 Sekunden.
- TRIG DELAY derart einstellen, dass der Triggerverzögerungswert alle 5 Sekunden um etwa 10 erhöht (oder herabgesetzt) wird. Auf diese Weise erhält man einen kontinuierlichen Durchlauf durch das Programms des Systems das geprüft werden soll.

Triggerqualifizierer

Der Triggerqualifizierer ist eine zusätzliches Bedingung für das gewählte interne Triggerwort sein und ist mit den Schaltern TRIGGER QUAL 1 oder 0 wählbar.
Dieser Eingang hat die gleichen Parameter wie die Dateneingänge, Storimpulsspeicherung ist vorhanden und kann als ein 17 Kanal für Triggererkennung angesehen werden.

Der Triggerqualifizierer erlaubt eine selektivere Datenerfassung durch Konditionierung des Triggersignals mit einer zusätzlichen Bedingung die "1" oder "0" sein kann.
Anschluss des Triggertastkopfs PM 8810 an diesen Eingang vergrössert die Triggerkapazität.

Cursor

Der Cursor ist ein verschiebbarer 16 Worte langer Teil des Speichers.
Das erste Wort des Cursors ist das eigentliche Cursorwort.

In Betriebart TIME ist der Cursor der aufgehellte Teil des Zeitdiagramms.
Die Position des Cursorworts bezogen auf das gewählte Triggerwort (oder Triggersignal) ist in der Textzeile der Anzeige angegeben.

In Betriebsart TABLE (Tabellierung) wird der gesamte Cursorinhalt dargestellt. Das erste Wort der Tabelle ist das Cursorwort.

In Betriebsart MAP ist der dem Cursor-Wort entsprechende Punkt einem 0 Zeichen markiert.
Die Position des Cursors relativ zum gewählten Triggerwort (oder Triggersignal) ist in der Textzeile angegeben.

Der Cursor kann schrittweise, kontinuierlich oder mit hoher Geschwindigkeit den Speicher durchlaufen. Kurzzeitigs Drücken der "+" oder "–" CURSOR Taste bewegt den Cursor nur ein Wort im Speicher. Wenn diese Tasten eingedrückt bleiben wird eine kontinuierliche Verschiebung durch den Speicher bewirkt. Wird zugleich Taste FAST gedrückt, dann wird die Durchlaufgeschwindigkeit erhöht.

Der Cursor kann an jede beliebige Stelle des Speichers gebracht werden und kann somit durch den gespeicherten Datenstrom "schieben".

Der Cursor dient somit als Betrachtungshilfe und eine bequeme Referenz bei der Umschaltung von Zeitdarstellung auf Tabellierung und zurück.

Blank (Unterdrückung)

Diese Funktion dient zur Wahl der Anzahl der Kanäle die auf dem Bildschirm dargestellt werden sollen.
Es ist zu beachten die BLANK–Funktion auf Datenerfassung und Triggerwahl keinen Einfluss hat.

In der Zeitdarstellung (TIME) werden die verbleibenden Kanäle neu gruppiert und in Gruppen von jeweils 4 Kanälen auf dem gesamten Bildschirm dargestellt.

Im Tabellierungsbetrieb bewirkt die Löschung eine Unterdrückung von Spalten, beginnend von links (Kanal 15) nach rechts (Kanal 9), die unterdrückten Kanäle werden in den HEX oder BIN Tabellen praktisch durch Nullen ersetzt.

In Betriebsart MAP führt Löschung "+" zu einer stufenweisen Reduzierung der Darstellung in Stufen (8 x 8, 7 x 8, 7 x 7, 6 x 7 usw.).

Anzeige

Auf dem Bildschirm der Elektronenstrahlröhre werden die verschiedenen Daten sowie die Textzeilen abhängig von der jeweils gewählten Darstellungsart und der Analysator-Betriebsart dargestellt.

Drei Darstellungsarten sind wählbar.

Time (Zeitdarstellung)

Nach Drücken der Taste "TIME" werden die Logiksignalpegel bezogen auf die horizontale Zeitachse gezeigt, so dass die Zeitbeziehung zwischen den Signalen deutlich sichtbar wird.
Um eine hohe Auflösung des Zeitdiagramms zu erhalten, ist er erforderlich eine Abtastfrequenz anzuwenden, die zumindest 5 bis 10 mal grösser ist als die Taktfrequenz des zu prüfenden Systems.
Taste CLOCK INT drücken. Die Frequenz ist mit Hilfe des Drehschalters SAMPLE INTERVAL einstellbar. Da zwischen dem Takt des Prüflings und dem Intervalltakt des Analysators keine Beziehung besteht spricht man von einem "asynchronem Takt".
Die Abtastintervalle werden durch Takt Marken angegeben.
Bei "0" Pegel sind die Takt Marken positiv gehend,
bei "1" Pegel negativ gehend, siehe Abb. 2.3.4.

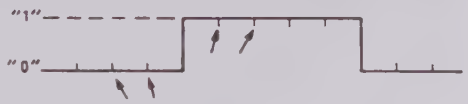


Abb. 2.3.4. Takt Marken

In Darstellungsart TIME kan die Zeitachse durch Drücken der Taste EXPAND gedehnt werden. Die Dehnung ist nacheinander x1, x10, x25. Bei Faktor 10 und Faktor 25 Dehnung ist als Cursorwort das erste Wort des Zeitdiagramms.

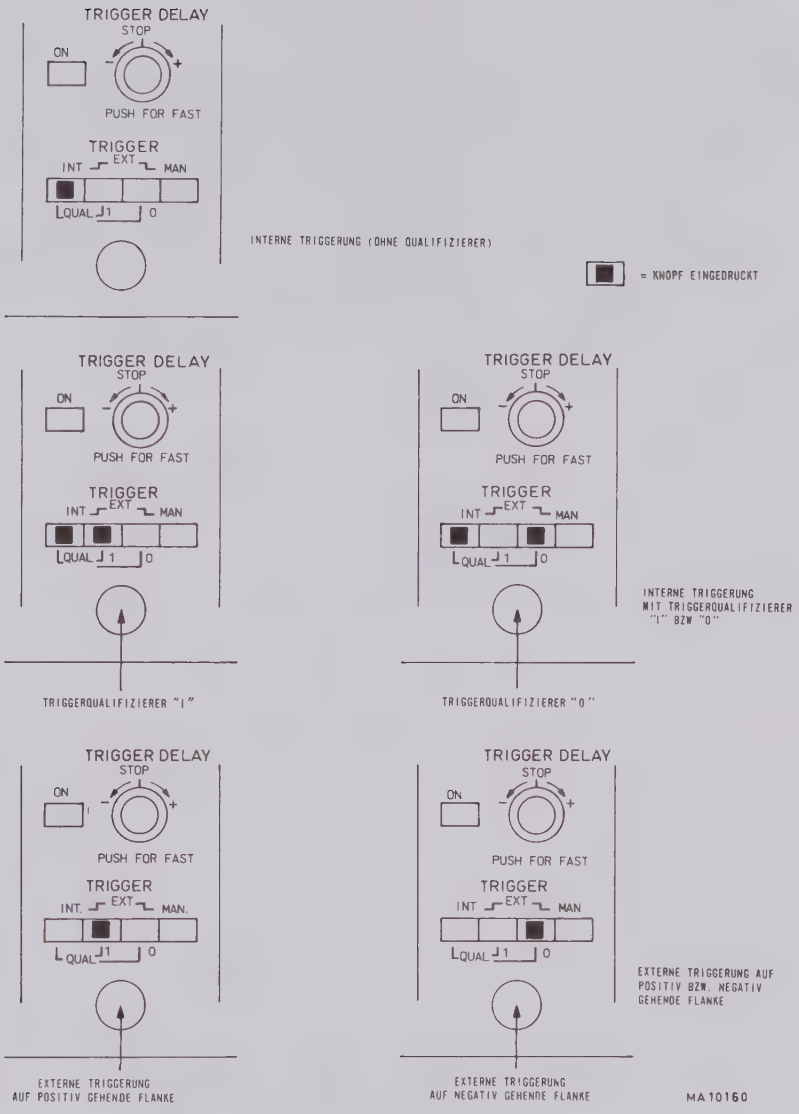


Abb. 2.3.2. Triggerschalterfunktionen

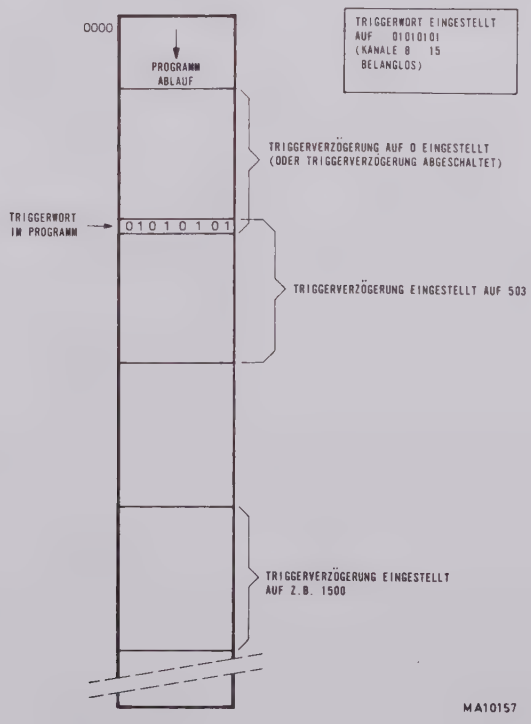

0000
PROGRAMM ABLAUF
TRIGGERWORT EINGESTELLT AUF 01010101 (KANALE 8 15 BELANGLOS)
TRIGGERVERZÖGERUNG AUF 0 EINGESTELLT (ODER TRIGGERVERZOGERUNG ABGESCHALTET)
TRIGGERWORT IM PROGRAMM
0 1 0 1 0 1 0 1
TRIGGERVERZÖGERUNG EINGESTELLT AUF 503
TRIGGERVERZÖGERUNG EINGESTELLT AUF Z.B. 1500
MA10157

Abb. 2.3.3. Triggerverzögerung

In den Textzeilen sind angegeben:

- der Dehnungsfaktor.
- die gewählte Triggerverzögerung.
- die Position des Cursorworts relativ zum Triggerwort.
- der Cursorwortinhalt, hexadezimal, oktal oder binär dargestellt, abhängig von den zuvor gewählten Tasten HEX, OCT, oder BIN.

Jeder Kanal wird mit seiner Kanalnummer an der linken Seite der Darstellung gekennzeichnet.

Table (Tabellierung)

Die Daten werden als Zeichen dargestellt (nach Drücken der HEX, OCT oder BIN Tasten).
Die parallelen Datenworte horizontal angeordnet, in von oben nach unten verlaufender Reihenfolge.

Diese Betriebsart wird für die sogenannten "Synchronen"-Messungen angewendet.

Der gesamte Cursorinhalt wird dargestellt (das erste Wort ist das Cursorwort).
Die Textzeilen der TABLE Darstellungsart zeigt:

- die eingestellte Darstellungsart
- die gewählte Triggerverzögerung
- eine Angabe welche Kanäle gewählt sind.

Jedes Datenwort ist relativ zum Triggerwort durchnumeriert.

Map

Nach Drücken der Taste MAP werden die Datenworte in Koordinatenwerte, dargestellt durch einen Punkt auf dem Bildschirm, umgewandelt. Jedem Wort ist sein eigener definierter Platz auf dem Schirm zugeordnet.
Die niedrigstwertige Hälfte des Wortes ist entlang der X-Achse (horizontal) und die höchstwertigste Hälfte ist entlang der Y-Achse (vertikal) dargestellt.
Das so erhaltene Punktmuster repräsentiert den gesamten gespeicherten Datenblock.

Der dem Cursorwort entsprechende Punkt ist mit einem "0" Zeichen markiert.

Wiederholt geschriebene Punkte besitzen eine proportional grössere Helligkeit, so dass mehrmals im Datenblock auftretende Worte leicht erkennbar sind.

Beim Löschen von Kanälen, wird die verbleibende Anzahl Kanäle gleichmässig über die X- und Y-Achse verteilt, so dass immer die gesamte Schirmfläche benutzt wird.

Die Textzeilen der Darstellungsart MAP zeigen:

- die eingestellte Darstellungsart
- die gewählte Triggerverzögerung
- die Position des Cursorworts relativ zum Triggerwort
- den Inhalt des Cursorworts (hexadezimal, oktal oder binär, je nach vorheriger Tastenwahl HEX, OCT oder BIN).

Auf der linken Seite der Anzeige ist angegeben welche Kanäle in Betrieb sind sowie ihre Anordnung.

Analysator Betriebsarten

Zwei Hauptbetriebsarten sind wählbar:

- SAMPLE (Abtastung) oder
- CAPTURE (Mitnehmen oder Einfangen).

Jede dieser Betriebsarten lässt sich mit der COMPARE-Funktion kombinieren.

Siehe Abb. 2.3.5. für SAMPLE- und CAPTURE-Betrieb.

Sample

Dies ist die grundlegende Betriebsart des Analysators, wobei die Daten an den Flanken des Taktimpulses erfasst werden (Taste SAMPLE drücken).
Datenerfassung kann synchron (Taktsignal vom System das geprüft werden soll) oder asynchron (mit dem eingebauten Taktgenerator des Analysators) erfolgen.
Datenerfassung beginnt mit der START Funktion und stoppt wenn Triggerung erfolgt.
Die Daten im Speicher des Analysators können entweder in TIME, TABEL oder MAP Darstellungsart angezeigt werden.

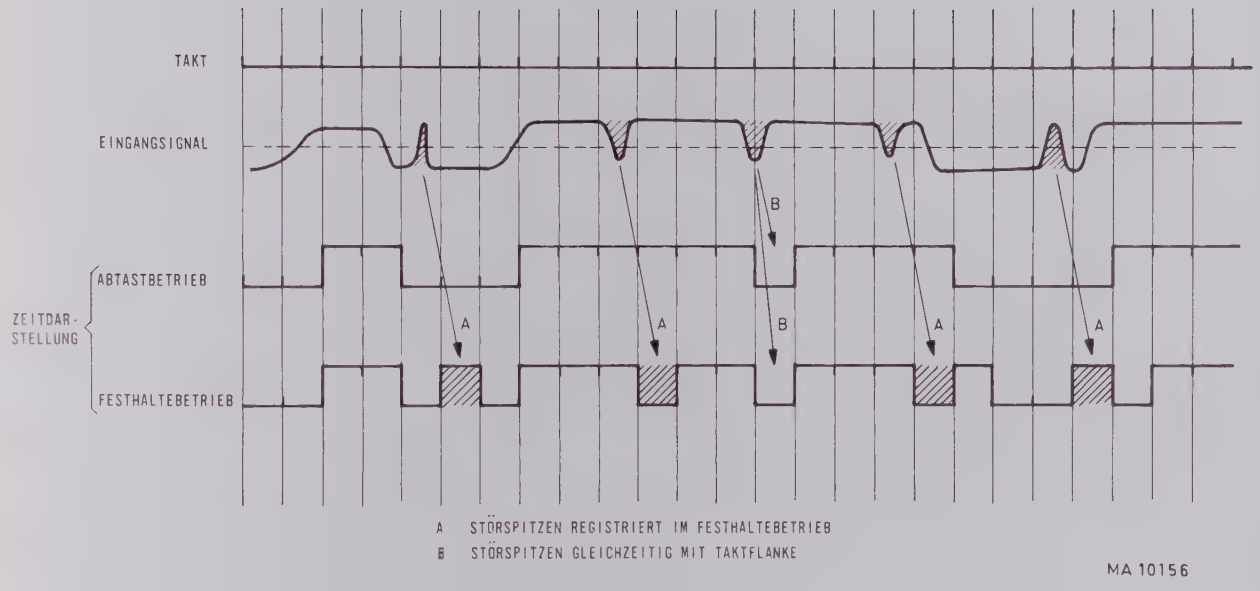
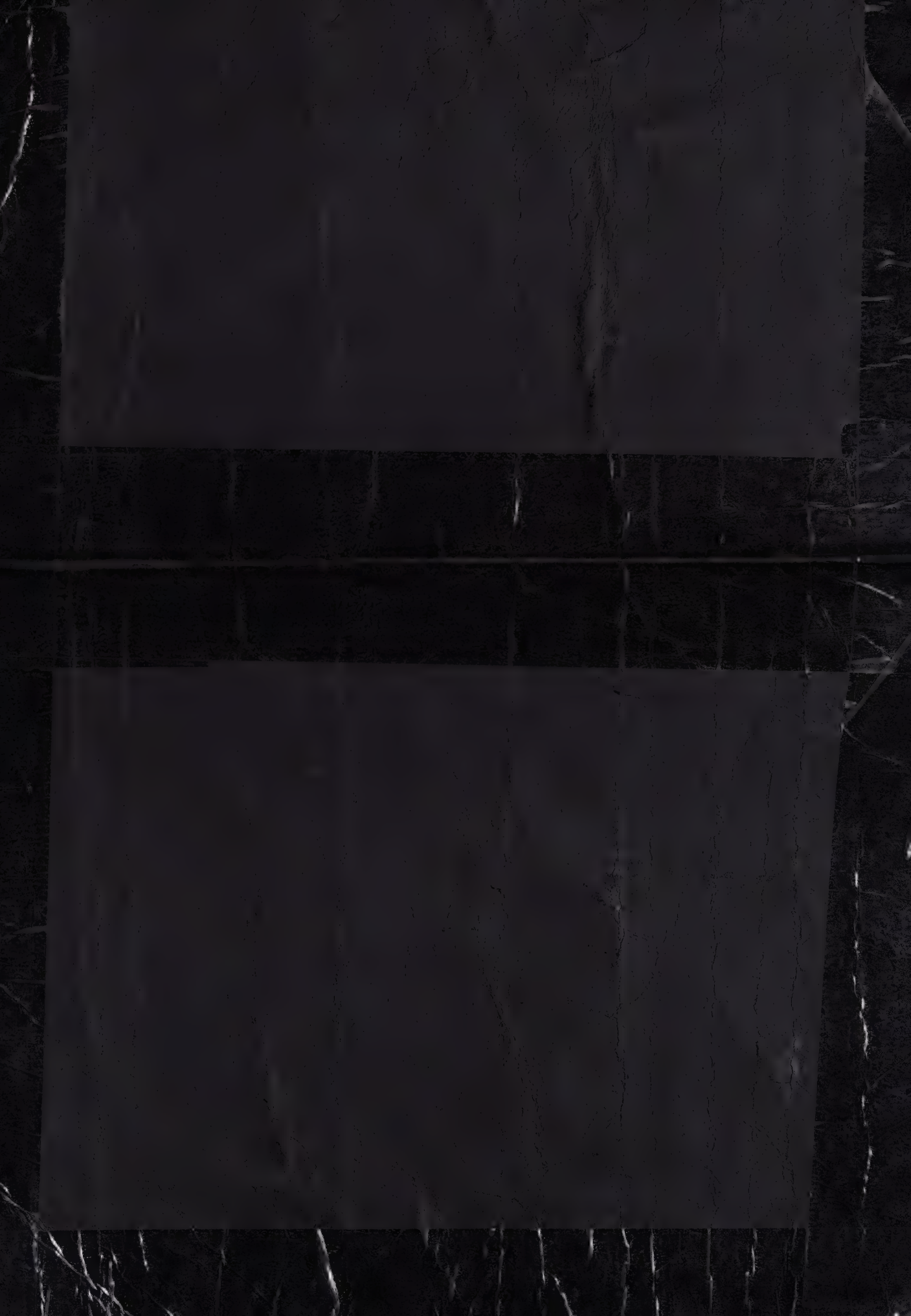


Abb. 2.3.5. Abtast- und Festhaltebetrieb



Capture

Betriebsart CAPTURE (gewählt durch Drücken der Taste CAPT) ist im Grunde die gleiche wie SAMPLE, jedoch werden nun Impulse (Glitches - das sind Störspitzen) die zwischen zwei Taktflanken erscheinen, festgehalten.
Sowohl positive gehende Störspitzen bei "0" Pegel und negativ gehende Störspitzen bei "1" Pegel werden ermittelt.
Störspitzen werden bis zur nächsten Taktflanke zwischengespeichert und für einen Taktintervall dargestellt.

Diese Fangschaltung kann in "langsamen" Datenströmen eingesetzt werden um Störspitzen zu erkennen ohne die Taktrate zu erhöhen.

Da die ermittelten Störspitzen (Glitches) durch diese Schaltung in "normale" Impulse umgeformt werden ist es möglich ein Triggerwort einzustellen welches den gleichen Logikzustand besitzt wie jene die bei Auftreten der Störspitze entstehen.

Es ist zu beachten, dass die Störspitzen-Fangmöglichkeit auch für den EXT TRIG Eingang gilt.

Compare (Vergleich)

Durch Drücken der COMPARE Taste lassen sich zwei Datenströme vergleichen.
Der Speicher des Analysators wird in zwei Hälften (beide 248 Worte tief) aufgeteilt.
Eine Hälfte ist der Suchdatenspeicher mit normaler Position auf dem Bildschirm, die andere Hälfte ist der Referenzspeicher.
Beide Tabellen werden nebeneinander dargestellt.

Falls die volle Speicherkapazität ausgenutzt werden soll, um Daten die unmittelbar nach dem Triggersignal eintreffen aufzunehmen ist eine Triggerverzögerung von 247 empfehlenswert.
Der Referenzspeicher wird durch Drücken der STORE REF Taste mit Daten geladen (Dies ist die Startfunktion; so bald die Triggerbedingung vorhanden ist wird die Referenztabelle dargestellt).
Der Suchdatenspeicher wird durch die normalen Start- und Triggerfunktionen gesteuert.

Jede Nichtübereinstimmung zwischen den beiden gespeicherten Datenblöcken wird durch aufgehellte Zeichen in der Suchtabelle selbst angezeigt.
Ausserdem erscheint in der Textzeile die aufgehellte Nachricht UNEQ wenn zumindest ein Bit im gesamten Datenspeicher ungleich ist.

Die Textzeilen in COMPARE Betriebsart zeigen:

- die gewählte Darstellungsart
- die gewählte Triggerverzögerung
- Angabe welche Kanäle gewählt sind
- das Ergebnis der Vergleichsfuntion:
  - EQ bei völliger Übereinstimmung beider gespeicherter Datenblöcke
  - UNEQ wenn zumindest ein Bit nicht übereinstimmt.

Beendigung der COMPARE Betriebsart erfolgt durch Rücksetzung der COMPARE Taste..

Search (Suchen)

Diese Betriebsart ist ein automatischer Vergleichsbetrieb, besonders geeignet für Daten die nur fallweise nicht übereinstimmen.
Die Referenzdaten werden erfasst wie unter "COMPARE" beschrieben.
Wenn nun die SEARCH Taste gedrückt wird, wird auf dem Schirm nur die Textzeile dargestellt.
Taste AUTO darf nicht gedrückt werden.
Wenn die Triggerbedingung für die Suchtabelle gefunden ist, wird die Suchzahl-Nummer um eins erhöht und das Gerät vergleicht beide Tabellen.
Wenn keine Ungleichheit gefunden wird, startet das Gerät von neuem, wartet auf die nächste Triggerbedingung und so weiter.

Sobald eine Ungleichheit zwischen Such- und Referenzdaten ermittelt wird, wird den Suchbetrieb beendet.
Beide Tabellen erscheinen auf dem Schirm so angeordnet, dass das erste fehlerhafte Datenwort im Cursorwort erscheint und das fehlerhafte Bit aufgehllt ist. Das Gerät ist jetzt wieder im "Compare"-Betrieb.

Die Wiederholrate des Suchbetriebs beträgt etwa 10 Hz. Wenn erforderlich kann das START Ausgangssignal auf der Rückseite des Analysators zum Starten des Programms des zu prüfenden Systems verwendet werden.

Im Betriebsart SEARCH wird in der Textzeile dargestellt:

– HEXT, OCT oder BIN TABEL SEARCH und die Zahl der durchgeführten Suchvorgänge.
Bei Nichtübereinstimmung: die gewählte Triggerverzögerung wird ebenfalls in der Textzeile dargestellt.

Wenn die SEARCH Taste wieder gedrückt wird, ist den Suchbetrieb abgeschaltet.

– AUSGÄNGE AUF DER GERÄTERÜCKSEITE

START

An diesem Ausgang ist ein positiv gehendes TTL-Signal beim Startmoment vorhanden. Mit diesem Signal kann das Programm eines Systems, das geprüft werden soll, synchron mit dem Analysator gestartet werden.

TRIGGER

An diesem Ausgang ist ein positiv gehendes ECL Signal vorhanden am Trigger-moment +4 Taktpulsen (in CAPTURE-Betrieb ein Impuls weniger). Die Verzögerung zwischen manuelle Triggerung und dem Ausgangsimpuls kann nicht vorausgesagt werden, doch wird sie maximal 10 Impulse betragen.
Dieses Signal kann zum Beispiel als Triggersignal für ein Oscilloskop benutzt werden.

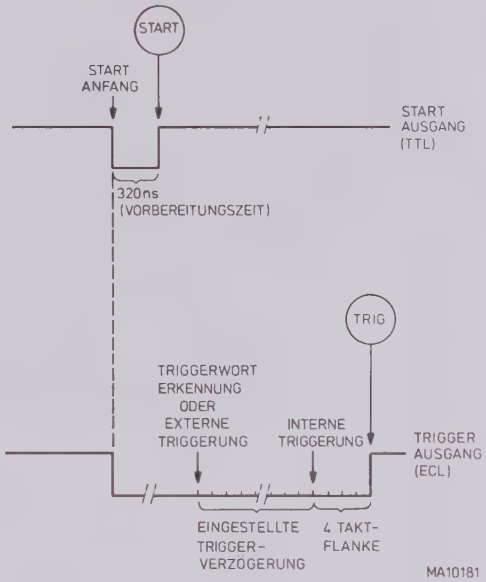


Abb. 2.3.6. Start- und Triggerausgangssignale

Bemerkung

Grundlegend gilt für den Analysatorbetrieb, wenn die Triggerverzögerung geringer ist als die Speichertiefe (oder die Triggerverzögerung ausgeschaltet ist) folgendes.

Wenn die Anzahl der Wörter (Eingangs-Abtastsignale) zwischen dem Startmoment und der Erkennung des Triggerworts geringer ist als die Speichertiefe + Triggerverzögerung, dann wird der Speicherbereich vor dem Triggerwort nicht vollständig mit neuen Daten beschrieben.

Da zwischen dem Startmoment (manueller Start, automatischer Start oder Suchbetrieb) und der Triggerung keine zeitliche Beziehung besteht, ist die Anzahl der Eingangs-Abtastsignale nicht voraussagbar (das Triggerwort könnte unmittelbar nach dem Startmoment erscheinen, so dass, ohne Triggerverzögerung, nur das Triggerwort im Speicher ist).

Um Datenströme gleicher Länge nach dem Startmoment zu erlangen, kann das START-aus Signal des Analysators für den Start des zu prüfenden Systems verwendet werden oder es kann ein Startsignal des zu prüfenden Systems an den EXT. START-Eingang des Analysators gelegt werden.
Auf diese Weise wird die Anzahl der Abtastungen zwischen Startmoment und Triggerung voraussagbar.

Vor allem im Suchbetrieb (SEARCH) ist dieses Verfahren äusserst nützlich.

Im PM 3500 wird beim Startmoment der gesamte Datenspeicher gelöscht (auf 1 gesetzt), die Eingangsschaltungen welche die Eingangssignale für den Speicher verarbeiten, werden jedoch nicht gelöscht.
Ein Beispiel dafür ist der in Abb. 2.3.7. gezeigten Anzeige zu entnehmen.
In dieser Abbildung repräsentieren die obersten drei Wörter (FFFF) einen Teil des Speichers dem überhaupt keine Daten zugeführt sind.

Die nächste Gruppe von Wörtern sind ungültige Daten, die sich noch von der vorigen Messung in der Eingangsschaltung befinden. Diese Gruppe umfasst maximal 12 Wörter.
Die restliche Gruppe besteht aus gültigen Daten.

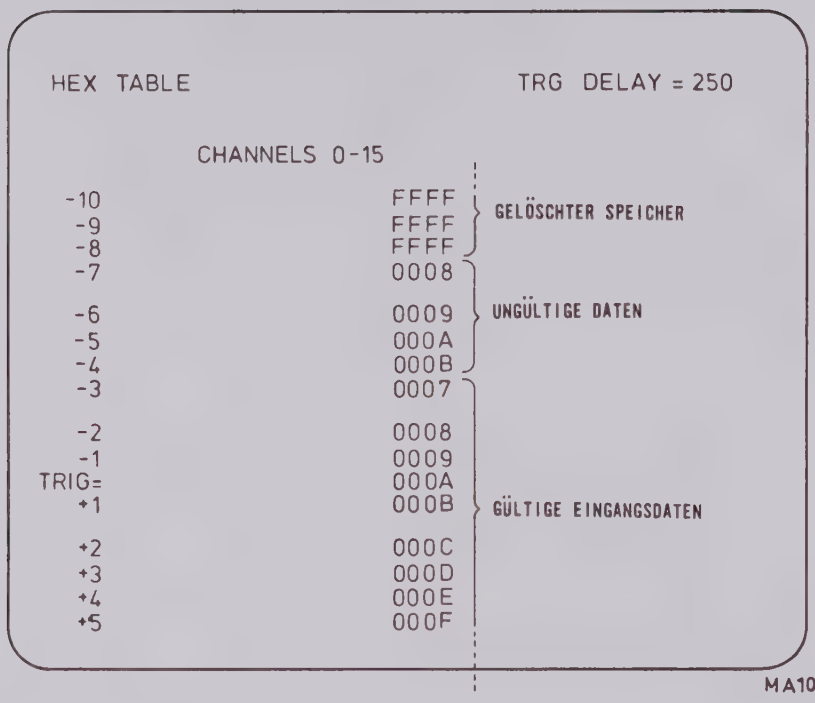


Abb. 2.3.7. Ungültige Daten

Eine Anzahl nicht gültiger Daten kann in der Anzeige vor den gültigen Daten erscheinen, falls die Triggerverzögerung geringer ist als die Speichertiefe.

2.4. WARTUNG

Erfahrungsgemäss ist zu erwarten dass das Gerät innerhalb von 1500 Betriebsstunden , oder neun Monaten bei Fallweisembetrieb innerhalb seiner Spezifikationen arbeitet.

Um verlässlichen und störungsfreien Betrieb zu gewährleisten, muss das Gerät vor Feuchtigkeit, Hitze, Korrosionsbildenden Elementen und übermässigen Staub geschützt werden.

Das Aussehen der Deck- und Bodenplatten des Gehäuses, beschichtet mit "Nextel-Sued" kann nach einiger Zeit verschlechtern.
Zur Reinigung einen weichen Bausch mit etwas Ethanol oder mit gewöhlichen Haushaltwaschmittel verwenden. Rauhe Tücher oder ätzende Reinigungsmittel dürfen nicht benutzt werden um Beschädigung der Oberflächen zu vermeiden.

WARNUNG: Der "Nextel-Suede" Lack ist Ethanol beständig, jedoch empfindlich gegen Brennspiritus, der die Oberfläche angreift (wegen der denaturierenden Bestandteile).

Reinigen der Frontplatte und Rückwand, sowie des Kontrastfilters der Elektronenstrahlröhre: keine Lösungsmittel wie Trichloräthylen oder Aceton verwenden.
Einen weichen Bausch, Tuch oder Watte mit etwas Wasser und einem gewöhlichen Haushaltwaschmittel oder etwas Alkohol oder weissem Spiritus verwenden.

Darauf achten, dass nach längeren Einsatz, die Öffnungen in den Gehäuseplatten nicht mit Staub verstopft sind.
Falls erforderlich Platten entfernen und die Öffnungen mit Druckluft freiblasen.

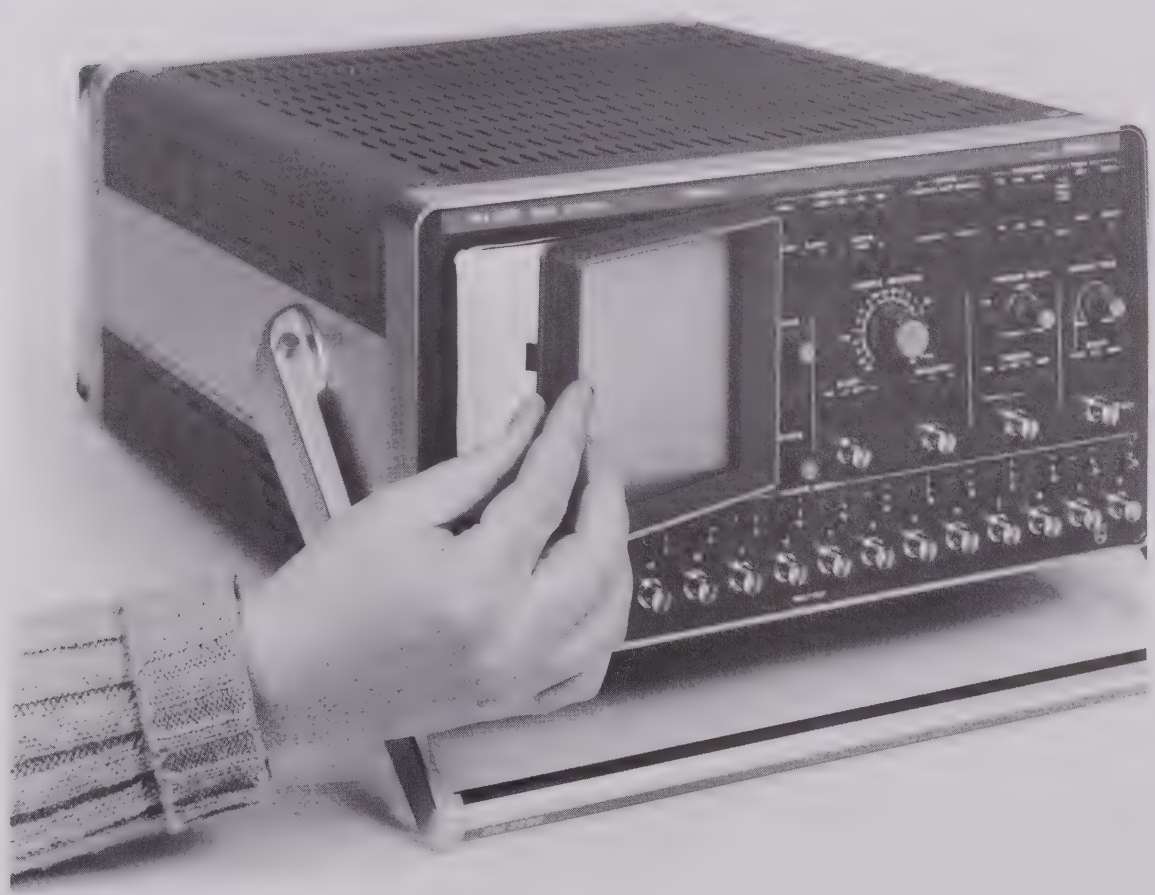


Abb.2.4 Abnemen der Bildröhremaske.

Notice d'emploi

1. INTRODUCTION

L'analyseur logique PM 3500 est un appareil à usages multiples, très utile pour examiner des flots de données complexes ou des signaux dans des systèmes digitaux.
Les signaux sont stockés dans la mémoire interne ayant une capacité de 504 mots de 16 bits.

L'appareil peut fonctionner soit sur horloge externe (généralement utilisée pour vérifier des problèmes de logiciel, de programmation, etc.) ou sur horloge interne (servant à contrôler des problèmes de temps, des suroscillations, des réflexions et autres).
L'horloge peut être combinée avec un qualificateur.

De plus, le mode capture disponible dans l'appareil permet de détecter des phénomènes transistoires appraissant entre deux fronts d'horloge.

Trois modes d'affichage peuvent être sélectionnés:

- Mode "diagramme des temps"
  Les signaux logiques sont affichés sous formes d'onde.
- Mode "représentation d'état"
  Les signaux logiques sont affichés sous forme de mots (à sélectionner entre l'affichage hexadécimal, octal ou binaire).
- Mode "représentation cartographique"
  La valeur de chaque mot d'entrée est convertie en une certaine valeur pour les coordonnées X et Y. Chaque mot est représenté par un point spécifique sur l'écran.

A noter que le mode comparaison permet de comparer un tableau de travail à un tableau de référence. En mode de recherche automatique, la fonction comparaison est effectuée automatiquement, de sorte que le tableau continuellement renouvelé est comparé avec le tableau de référence.

Le déclenchement, qui arrête l'enregistrement des données, peut être:

- interne; le mot de déclenchement est sélectionné à l'aide de 16 commutateurs situés au-dessus des connecteurs d'entrée.
  L'adjonction d'un qualificateur est possible;
- externe; à sélectionner sur le front positif ou négatif d'un signal externe;
- manuel; par bouton-poussoir.

L'armement, qui démarre l'enregistrement des données, peut être:

- automatique; démarre répété de l'enregistrement de données.
  Le temps s'écoulant entre deux démarrages successifs est réglable par le bouton Display Time (temps d'affichage);
- externe; avec un signal au niveau TTL;
- manuel; par bouton-poussoir.

Les niveau de seuil logiques des entrées sont réglables sur deux groupes de huit. Un groupe comprend en plus les entrées pour horloge externe, qualificateur et déclenchement. Les niveaux de seuil logiques peuvent être TTL, ECL ou au choix de l'utilisateur (–9 V ... +9 V).
Ces valeurs s'appliquent uniquement si les sondes PM 8800 adéquates sont utilisées.

CARACTERISTIQUES TECHNIQUES

Le présent appareil est conçu et testé selon la norme CEI 348 pour appareils de classe I et est livré dans des conditions de sécurité. La notice d'instruction contient les informations et avertissements destinés à l'acheteur afin d'assurer le fonctionnement en toute sécurité et de maintenir l'appareil dans ces conditions de sécurité.

Les spécifications mentionnées sont valables si l'appareil a été préchauffé pendant 15 minutes. Les propriétés exprimées en valeurs numériques avec indication de tolérance sont garanties par le fabricant. Les valeurs numériques sans tolérances sont typiques et représentent les caractéristiques d'un appareil moyen.

Les données d'entrée pour horloge, déclenchement et qualificateur sont spécifiées pour l'usage du présent appareil en combinaison avec les sondes PM 8800.

Données d'entrée

Nombre	:	16 voies
Impédance	:	5 MΩ//13,5 pF
Tension maximale	:	–250 V ... +250 V
Seuil	:	Sélection indépendante pour les voies 0-7 et 8-15. Sélection par boutons-poussoirs pour TTL, ECL et niveau variables. TTL : +1,4 V (⩽ 0,8 V = "0"; ⩾ 2 V = "1") ECL : –1,3 V (⩽ –1,63 V = "0"; ⩾ –1,065 V = "1") VAR : –9 V ... +9 V continûment réglable. Possibilité de lire le niveau de seuil variable à partir du point test sur le panneau avant (R_{int} = 1 kohm)
Sensibilité maximale	:	Amplitude minimale du signal: 500 mV_{cc} centrée sur le seuil pour enregistrement à 100 MHz.
Temps d'établissement et de maintien	:	Etablissement: 1 nsec Maintien: 2 nsec
Largeur d'impulsion	:	par rapport au front d'horloge interne actif En mode d'échantillonage: un intervalle +3 nsec En mode capture: ⩽ 3 nsec, avec un signal d'amplitude de 400 mV
Retard entre différentes entrées	:	Inférieur à 2 nsec.

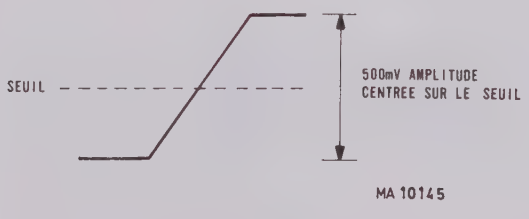


Fig. 1.1. Amplitude minimal du signal

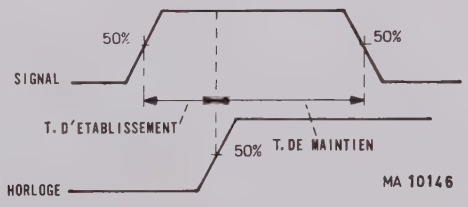


Fig. 1.2. Temps d'établissement et de maintien

Horloge

Source	:	Sélection interne ou externe
Horloge interne	:	Controlée par quartz Sélection à partir du panneau avant, de 10 nsec à 20 msec d'intervalle d'échantillonnage à l'aide d'un commutateur à 20 positions en séquence 1-2-5.
Horloge externe	:	Entrée par sonde PM 8800 via des connecteurs BNC sur le panneau avant. Même spécifications que pour l'entrée de données. Vitesse maxi: 60 MHz Si le taux d'horloge est inférieur à 50 Hz, le message NO/SLOW CLOCK est affiché tandis que les fonctions d'analyseur restent operationnelles. Largeur minimale d'impulsion: 5 nsec. Sélection du seuil par choix des voies 0 à 7. A partir de la version -/03, le seuil peut également être réglé sur TTL, indépendamment de la sélection des voies 0 ... 7. Il est possible d'échantillonner sur le front positif ou négatif de l'horloge. Retard entre l'horloge externe et l'entrée des donnèes: 15 ns typique.
Qualificateur d'horloge	:	Entrée par connecteur BNC sur le panneau avant. Mêmes spécifications que pour l'entrée des données. Seuil identique à celui des voies 0 ... 7. L'échantillonnage est réalisé si ce qualificateur est "vrai" au front d'horloge. La position "vrai" peut être soit le "1" (haut) soit le "0" (bas) logique. En position "indifférent" ("X") le qualificateur n'est pas utilisé. Temps d'établissement = 4 nsec, temps de maintien = 3 nsec par rapport au front d'onde réel en bout de sonde.

Déclenchement

Source	:	Sélection interne, externe ou manuel.
Déclenchement	:	En mode échantillonnage: sur signaux dont la largeur d'impulsion est d'un temps d'intervalle + 3 nsec. En mode capture: $\geqslant$ 3 nsec.
Interne	:	Le déclenchement se fait par reconnaissance sur 16 voies et qualificateur. La combinaison du mot de déclenchement est définie par 16 commutateurs à trois positions ("1", "0" et "X"-indifférent). Le déclenchement ne se fait que s'il y a égalité entre un mot présent à l'entrée et une combinaison sélectionnée.
Externe	:	Entrée via un connecteur BNC sur le panneau avant. Mêmes spécifications que pour l'entrée des données. Seuil de déclenchement identique à celui des voies 0 à 7. A partir de la version -/03, le seuil peut égelement être réglé sur TTL, indépendamment de la sélection des voies 0 ... 7. Déclenchement possible sur le front de montée ou de descente du signal de déclenchement.
Manuel	:	Déclenchement par bouton-poussoir.

Qualificateur de mot de déclenchement	:	Identique aux spécifications de déclenchement externe, mais combiné avec la sélection interne (''INT''). Le mot de déclenchement est conditionné par le qualificateur de mot ''vrai''. ''Vrai'' peut être ''1'' haut, ''0'' bas et ''X'' indifférent.
Retard de déclenchement	:	Le déclenchement peut être retardé par 0 ... 9999 impulsions d'horloge réglées par un compteur contrôlé en vitesse. Les modes d'enregistrement retardé déclenchement central, post-déclenchement, déclenchement retardé peuvent être effectués à l'aide de cette simple commande.

ARMEMENT

Mode	:	Automatique, externe ou manuel.
Automatique	:	L'appareil est armé automatiquement à une fréquence fonction du temps d'affichage variable d'environ 1 à 10 sec (± 20 %).
Externe	:	Par impulsion externe sur une entrée BNC (panneau avant). Armement sur niveau ''0'' TTL (≥ 40 ms). Résistance internelle à +5 V: 2,74 kOhm.
Manuel	:	Par bouton-poussoir.
MEMOIRE	:	La capacité de la mémoire est de 504 mots. En mode comparaison, la mémoire est divisée en deux parties de 248 mots chacune. Un mot est formé de 16 bits.

MODES D'OPERATION

Echantillonnage	:	Les signaux d'entrée sont mémorisés en fonction de la transition de l'horloge d'échantillonnage et du seuil choisi. La largeur d'impulsion minimale **toujours** enregistrée est d'un intervalle d'échantillonnage +3 nsec pour une amplitude de 250 mV ou plus au dessus de la tension de seuil.
Capture	:	Ce mode permet de détecter des parasites plus courts qu'un intervalle d'échantillonnage, limite minimale: 3 nsec, pour une amplitude de 400 mV au dessus de tension de seuil; pour des parasites de 4 nsec min. la tension est de 250 mV. Il maintient le parasite capturé jusqu'au front d'horloge suivant et l'affiche pendant un intervalle d'échantillonnage.
Comparaison	:	La moitié de la capacité de mémoire est réservée pour conserver la table de référence. En mode de représentation sous forme de tableaux, le tableau de référence et le tableau des données actuelles sont affichés simultanement. Les erreurs détectées par l'appareil dans les données capturées (248 mots) se traduisent par l'intensification de caractères et le message ''UNEQ'' est affiché.
Enregistrement de référence (Store Ref.)	:	Les données de référence sont acquises, mémorisées et affichées. Les données de référence sont conservées jusqu'à interruption du mode ''comparaison''.
Recherche automatique (Search Mode)	:	Les données sont acquises automatiquement et continûment dans la mémoire de 248 mots et comparées aux données de référence. En cas d'inégalité entre les tableaux, la procédure est arrêtée et les deux tableaux (de référence et des dernières données capturées) sont affichés. Les inégalités sont intensifiées. Le mot curseur se trouve sur la première ligne d'inégalité. Le nombre de recherches est compté et indiqué en-tête.

AFFICHAGE

Tube : Philips D18-120GH
10 x 12 cm, 10 kV, déflection électrostatique.

Type d'écran : P31 (GH)
Contrôle de la focalisation et de la luminosité sur le panneau avant.

Rotation de trace : Réglage interne.
Dans la partie supérieure de l'écran, un en-tête clair est affiché indiquant l'état de l'appareil et les principaux paramètres.

Curseur : Le curseur sert de référence pour toutes le données capturées et est commandé à l'aide de 3 boutons-poussoirs: deux donnent la direction en incréments d'un intervalle d'échantillonnage ou continûment, un autre permet une avance plus rapide.
Le curseur contient 16 mots.
Le premier mot indique la position réelle du curseur et est affiché dans le sommaire ainsi que le numéro de ligne en vue du positionnement. Le numéro de ligne est la distance relative (en échantillons) entre chaque mot et le mot de déclenchement.

Mode d'affichage :

— Diagram de temps:

16 voies divisées en 4 groupes de 4 voies horizontales.

Loupe: l'axe des temps peut être dilaté par 10 ou 25 par un bouton-poussoir.

La position du curseur sert de démarrage à l'affichage des temps dilatés.

— Représentation sous forme de tableau:

Ce mode peut être choisi en binaire, hexadécimal ou octal.
Les 16 mots contenus dans le mot curseur sont affichés; les mots sont précédés par les numéros de ligne.
La position du curseur est indiquée par le numéro de ligne du premier mot.

— Représentation cartographique:

Chaque mot est représenté par une position unique sur l'écran, la partie du mot la moins significative étant affichée sur l'axe horizontal et la partie la plus significative sur l'axe vertical.
Le curseur est indiqué par un signe "0" et est visible dans l'en-tête.
L'intensité lumineuse des points dépend du degré de répétition des mots correspondants.

Effacement (Blank) : L'information sur les voies peut être supprimée en succession à partir de la voie 15 en enfonçant le bouton BLANK +.
Le rappel est effectif en actionnant le bouton BLANK —.
En mode diagramme des temps, les voies restantes sont rassemblées par groupe de 4 voies sur la totalité de l'écran.
En mode de représentation tableau, les colonnes sont supprimées en partant de la gauche (voie 15).
En mode de représentation cartographique l'effacement a pour effet de réduire les coordonnées de la carte de 8 x 8 à 7 x 8, 7 x 7, etc. mais conserve la surface totale de l'écran.

SORTIES

Par connecteurs BNC à l'arrière.

Sortie de déclenchement : Niveau ECL, transition bas-haut au moment du déclenchement.

Sortie synchro : Niveau TTL, transition bas-haut au moment du réarmement.

Voir également Fig. 2.3.6.

ALIMENTATION

Consommation	:	110 W – 160 VA	
Tension et fréquences secteur	:	110 - 127 V en alternatif ± 10 % 220 - 240 V en alternatif ± 10 % 48 - 440 Hz	Fusibles secteur 3,15 A lent (2x) pour les 2 tensions secteur
Conditions de sécurité	:	Conforme au standard CEI 348.	

CONDITIONS D'ENVIRONNEMENT

Les données concernant les conditions de fonctionnement ne sont valables que si l'appareil est testé en accord avec la procédure officielle. Les détails de cette procédure peuvent être communiqués à la demande de l'organisation Philips dans votre pays ou par N.V. PHILIPS' GLOEILAMPENFABRIEKEN, TEST AND MEASURING DEPARTMENT, EINDHOVEN, PAYS-BAS.

Température ambiante	:	–10 °C ... +40 °C pour utilisation normale. –40 °C ... +70 °C pour stockage et transport
Essais cycliques de chaleur humide	:	21 jours à température ambiante de +25 °C à +40 °C; humidité relative 95 %
Chocs	:	30 g, demi-sinus, durée 11 ms; 3 chocs par axe dans chaque direction, total 12 chocs.
Vibration	:	3 g vibrations 15 min. dans chacune des trois directions. 10 minutes en fréquence 15 ... 25 Hz et amplitude de 1 mm crête-à-crête. 5 minutes en fréquence 25 ... 55 Hz et amplitude de 0,5 mm crête-à-crête.

DIMENSIONS ET POIDS

Hauteur	:	200 mm
Largeur	:	386 mm
Profondeur	:	470 mm
Poids	:	14 kg

ACCESSOIRES FOURNIS AVEC L'APPAREIL

- 5 jeux de 4 sondes chacun (PM 8800).
- Mode d'emploi-notice de service.

ACCESSOIRES EN OPTION

- Sonde de déclenchement PM 8810.

2. MODE D' EMPLOI

2.1. DESCRIPTIONS DES COMMANDES ET CONTROLES

Fig. 2.1. Vue avant

TUBE A RAYONS CATHODIQUES

INTENS - OFF	:	Fonctions combinées; interrupteur marche/arrêt et réglage d'intensité.
FOCUS	:	Réglage du foyer
POWER ON	:	Lampe témoin

AFFICHAGE

TIME	:	Sélecteur de diagramme des temps
MAP	:	Sélecteur de représentation cartographique.
HEX	:	Sélecteur de représentation sous forme de tableau en format hexadécimal. Le contenu du curseur est affiché.
OCT	:	Sélecteur de représentation sous forme de tableau en format octal. Le contenu du curseur est affiché.
BIN	:	Sélecteur de représentation sous forme de tableau en format binaire. Le contenu du curseur est affiché.
EXPAND	:	Sélecteur de loupe, permet des grossissements successifs x1, x10 et x25.
BLANK	:	Deux boutons-poussoirs "+" : Les voies sont effacées à partir de la voie 15 tant que ce bouton est actionné. "–" : Les voies effacées sont affichées à nouveau dans l'ordre inverse de l'effacement réalisé avec le bouton "+".

CURSOR : Trois boutons-poussoirs

"–" : sens gauche en mode diagrammes des temps et vers le haut en modes représentations sous forme de tableau.

"+" : sens droite en mode diagramme des temps et vers le bas en modes représentation sous forme de tableau.

FAST : Si un des boutons de direction est actionné avec le bouton FAST, le curseur ira 15 fois plus vite.

. Possibilités: pas à pas et, après un certain retard, en continue.
. Le contenu du curseur est de 16 mots.

MODE

SAMPLE : Bouton-poussoir
Les données sont échantillonnées à chaque top d'échantillonnage sélectionné (interne) ou à chaque top d'horloge externe.

CAPT : Bouton-poussoir
Dans ce mode, les données à largeur d'impulsion minimale de 3 nsec entre transitions d'horloge peuvent être capturées et sont affichées pendant l'intervalle d'échantillonnage suivant.

COMP : Bouton-poussoir

. La mémoire est divisée en deux parties égales de 248 mots, dont l'une est réservée à une table de référence.
. L'affichage montre, dans les modes de représentation sous forme de tableau, deux tables d'une longueur de 248 mots. Si les tables ne sont pas identiques, les bits erronés sont intensifiés sur l'écran.

En mode comparaison, les commandes suivantes peuvent être utilisées:

STORE REF : bouton-poussoir, démarre l'enregistrement dans la mémoire de référence.

SEARCH : bouton-poussoir, démarre l'enregistrement automatique, par lequel toutes les données sont comparées au tableau de référence. L'enregistrement s'arrête dès qu'un bit est différent.

SEUIL

La section seuil consiste en deux groupes égaux de commandes:

TTL : Sélecteur de seuil pour adapter le comparateur d'entrée, à la logique TTL.

ECL : Bouton-poussoir facilitant les mesures en logiques ECL.

VAR : Bouton-poussoir permettant un réglage de seuil variable de –9 V à +9 V

ADJ. : réglage par tournevis pour choisir un seuil variable

MEAS : point de mesure du seuil de déclenchement.

: Un groupe commande les entrées :
- voie 7 - 0.
- horloge
- qualificateur d'horloge
- déclenchement

: L'autre groupe commande :
- les voies 15 - 8.

HORLOGE

INT : Sélecteur d'horloge d'échantillonage interne.

EXT : Bouton-poussoir ⌐ : sélectionne l'horloge externe sur son front de montée.

: Bouton-poussoir ⌙ : sélectionne l'horloge externe sur son front de descente.

SAMPLE INTERVAL

Entrée: connecteur BNC pour l'horloge externe. 1 MOhm//15 pF, tension maxi de ± 50 V en continu.

: Commutateur rotatif à 20 positions en progression 1-2-5. Sélecteur d'intervalle d'échantillonnage de 10 nsec à 20 msec pour l'horloge interne.

QUALIFICATEUR D'HORLOGE : L'échantillonnage d'horloge est contrôlé par ce qualificateur.
Le bouton-poussoir "1" permet de sélectionner "vrai" pour niveau haut.
Le bouton-poussoir "0" permet de sélectionner "vrai" pour niveau bas.
En position X le qualificateur est hors service.

DECLENCHEMENT

INT : Sélecteur de déclenchement interne par reconnaisseur de mot.

EXT : Bouton-poussoir " ⌐ " : déclenchement externe sur front de montée.

: Bouton-poussoir " ⌙ " : déclenchement externe sur front de descente.

: Entrée: connecteur BNC pour une impulsion de déclenchement externe (1 MOhm//15 pF, tension maximale ± 50 V continu).

MAN : Arrêts manuel des enregistrement.

TRIGGER DELAY : Bouton-poussoir ON: autorise l'utilisation du retard au déclenchement.
Commande rotative: "–STOP+" sert à choisir le retard au déclenchement.
"+" comptage jusqu'à 9999.
"–" décomptage.

START

AUTO : Sélection du démarrage automatique.

DISPLAY TIME : bouton de réglage du temps d'affichage de 1 à 10 sec.

EXT : Démarrage externe sur une impulsion TTL négative par l'entrée BNC

MAN : Démarrage manuel des mesures.

TRIGGER WORD

1
X
0 : 16 commutateurs à trois positions permettent de choisir le mot de déclenchement. Si une égalité est obtenue entre les entrées et le mot de déclenchement sélectionné, le reconnaisseur de mot génère une impulsion de déclenchement.

2.2. MISE EN SERVICE

GENERALITES

La présente décrit les travaux et précautions requises à l'installation du PM 3500. De plus, elle décrit en bref les fonctions des commandes et indicateurs, et met en évidence les aspects pratiques du fonctionnement. De la sorte, un opérateur peut rapidement se familiariser avec les fonctions principales de l'appareil.

Le présent appareil est protégé conformément aux règlements de sécurité standard classe I CEI 348.

Branchement sur le secteur et fusibles

Régler l'adaptateur secteur sur le panneau arrière, sur la tension d'alimentation adéquate.
Les deux porte-fusibles (panneau arrière) portent des fusibles lents 3,15 A. S'assurer que des fusibles correctement calibrés et du modèle convenable sont utilisés en cas de remplacement. Il faut éviter d'utiliser des fusibles réparés et de court-circuiter des porte-fusibles. En case de remplacement d'un fusible l'appareil doit être débranché de toutes sources de tension.

Mise à la terre

Avant toute mise sous tension, l'appareil doit être connecté à la terre de l'une des manières suivantes:

- Par la borne de terre de l'appareil (symbole ⏚).
- Par le cordon secteur à trois conducteurs.

ATTENTION : Toute interruption de la ligne de terre, à l'intérieur ou à l'extérieur de l'appareil ou le débranchement de la borne de terre peuvent rendre l'appareil dangereux. L'interruption intentionnelle est formellement interdite.
Lorsqu'un appareil passe d'un endroit froid à un endroit chaud, la condensation peut provoquer un certain risque. en conséquence, il faut appliquer strictement les prescriptions de mise à la terre.

Installation

Avant de procéder à toute autre connexion, la borne de terre de l'appareil doit être reliée à la ligne de terre du réseau (voir mise à la terre).

ATTENTION : L'ouverture des capots ou la dépose d'organes, à l'exception de ceux directement accessibles à la main sont susceptibles de mettre à jour des composants et des connecteurs sous tension.

L'appareil doit être débranché de toute source de tension avant de procéder à un réglage, un remplacement, une opération d'entretien ou une réparation demandant l'ouverture de l'appareil.
Au cas où le réglage, l'entretien ou la réparation de l'appareil ouvert sous tension sont inévitables, seule une personne qualifiée peut se charger de cette tâche.
Ne pas oublier que les condensateurs à l'intérieur de l'appareil peuvent être chargés, même si l'appareil est déconnecté de toute source de tension.

Refroidissement

Veiller à ce que la circulation naturelle d'air ne soit pas entravée. Ne pas placer l'appareil sur une surface produisant ou rayonnant de la chaleur.
Ne pas poser d'autres appareils ou papier sur l'apareil afin d'éviter l'échauffement excessif.

Protection de surcharge

En cas de courant excessif (ou température excessive), l'alimentation incorporée est mise hors service. Le témoin POWER est éteint.

Le même phénomène peut avoir lieu si la tension secteur est interrompue à plusieurs reprises. Dans ce cas, mettre hors circuit à l'aide du commutateur POWER à l'avant, laisser refroidir l'appareil pendant au moins 5 minutes et mettre à nouveau sous tension.

Poignée

La poignée peut être tournée en appuyant sur les boutons aux pivots.

Enclenchement

Le commutateur POWER est incorporé dans la commande INTENS (panneau avant). L'appareil ne doit jamais être enclenché lorsqu'une platine ou un bloc a été enlevé.
Ne jamais enlever une platine ou un bloc si l'appareil est mis hors service pendant au moins une minute.

Test d'initialisation

A l'enclenchement le microprocesseur démarre un programme test pour contrôler les environs immédiats du microprocesseur.

Test service

L'appareil est pourvu d'un programme test pour localiser toute défaillance fonctionnele. Le programme est sélectionné à l'aide d'un commutateur sur le circuit de microprocesseur.
Pour plus de détails, se réfere à la section "Service" de la documentation.

Réglage initial

Les modes ou valeurs initiales sont réglées automatiquement à l'enclenchement.

- Mode d'affichage TIME X1
- Toutes les voies (16) disponibles
- Curseur en début de mémoire
- Retard au déclenchement 503 (bouton ON enfoncé).

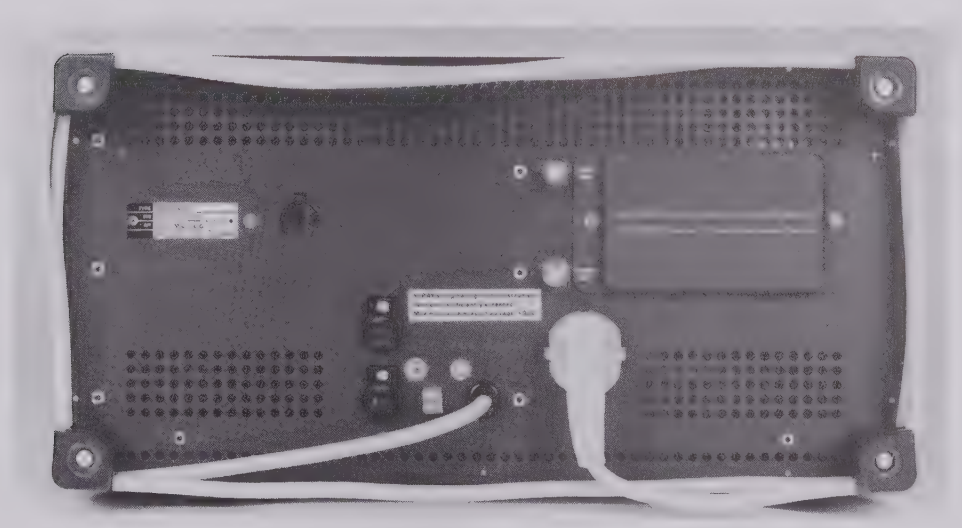


Fig. 2.2. Vue arrière, l'adaptateur secteur et fusibles

2.3. FONCTIONNEMENT

Entrée

Les signaux à afficher doivent être appliqués aux entrées (panneau avant) 0 ... 15 par les sondes PM 8800. Si les entrées ne sont pas toutes requises, commencer la connexion à partir de l'entrée 0 (voir chapitre "suppression des voies").

La connexion de terre appropriée est strictement recommandée pour chaque sonde d'entrée.

Seuil

Pour obtenir une détection appropriée des niveaux d'entrée, la tension de seuil doit être réglée de façon correcte.
Ceci est réalisé automatiquement pour les niveau TTL et ECL; un seuil variable (VAR) est incorporé.
A noter que les valeurs de seuil ne s'appliquent que si les sondes PM 8800 sont employées (atténuation de tension 1:5).
Pour régler la valeur de seuil en mode VAR, connecter un voltmètre à la sortie MEAS correspondant à l'entrée adéquate et ajuster avec le potentiomètre correspondant (par tournevis). La valeur de seuil peut être sélectionnée séparément pour les entrées 0 ... 7 et 8 ... 15. La valeur de seuil sélectionnée pour les entrées 0 ... 7 s'applique également aux entrées: CLOCK (horloge), CLOCK QUALIFIER (qualificateur d'horloge) et TRIGGER (déclenchement).
L'entrée EXT. START n'est valable que pour les niveaux TTL.
A partir de la version -/03 l'entrée EXT TRIG/TRIG QUAL (déclenchement externe/qualificateur de déclenchement) et l'entrèe CLOCK QUAL (qualificateur d'horloge) peuvent être réglées sur TTL, indépendemment du réglage de seuil des voies 0 à 7.
Pour ce faire on applique des cavaliers sur le circuit imprimé microprocesseur, comme illustré à la figure 2.3.1.

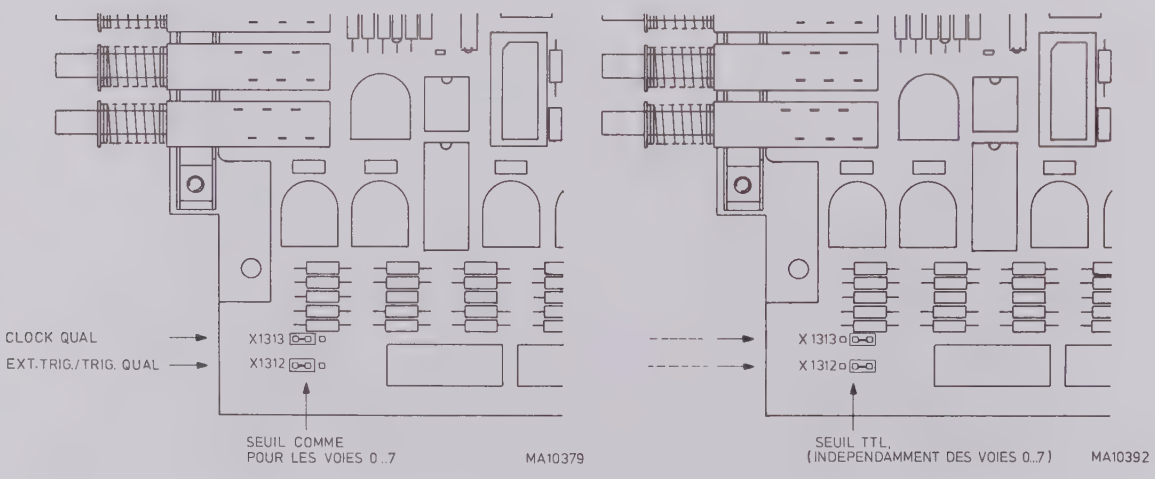


Fig. 2.3.1. Seuil d'entrée pour EXT TRIG/TRIG QUAL et CLOCK QUAL à partir de la version -/03.

Entrée d'horloge

L'horloge est un signal à répétition servant à déterminer la fréquence des échantillons pris à l'entrée. A chaque impulsion d'horloge, un échantillon des signaux d'entrée est pris et mémorisé. La fonction précédente est demarrée par "START" et arrêtée par "TRIG".

Horloge EXTerne

Le signal d'horloge peut être issu du générateur d'horloge incorporé dans le système à tester.
Cette horloge est appelée horloge synchrone, car l'échantillonnage de l'analyseur est synchrone au système testé. L'horloge peut être sélectionnée sur le front positif ou négatif de l'horloge du système.

Le mode d'horloge externe est communément utilisé pour des problèmes de logiciel tels que programmes et autres.
Les paramètres pour connexion de l'entrée horloge externe sont identiques à ceux des entrées 0 ... 7.

Horloge INTerne

L'avantage de l'horloge interne est que généralement, les échantillons pris au système sous test peuvent avoir une fréquence de beaucoup supérieure à celle de l'horloge du système. Les problèmes de diagramme des temps sont ainsi plus faciles à examiner (comparaison d'impulsions); cette horloge est appelée asynchrone.
La vitesse d'échantillonnage peut être sélectionnée à l'aide du bouton SAMPLE INTERVAL entre 20 ms et 10 ns (50 Hz à 100 MHz) en échelons de 1, 2 et 5.

Qualificateur d'horloge

Le qualificateur d'horloge permet une acquisition plus sélective des données en ajoutant une condition à l'horloge, à savoir "1", "0" ou "X" (indifférent). A sélectionner à l'aide des boutons QUALIFIER 1, X ou 0.

Démarrage

La fonction de démarrage commande le moment où l'analyseur commence à prendre des données, elle peut commencer de trois façons:

- AUTOmatique
- EXTerne
- MANuel.

En mode automatique (enfoncer le bouton AUTO) les données sont à nouveau reprises toutes les 1 à 10 secondes, à régler avec le bouton de commande DISPLAY TIME.
Le démarrage externe (enfoncer le bouton EXT) est possible avec un signal TTL front négatif séparé, appliqué sur le panneau avant approprié.
Le démarrage manuel est obtenu en enfonçant le bouton MAN.

Déclenchement

Le déclenchement arrête l'admission du flot de données, de sorte que le contenu de la mémoire reste stable et est disponible à l'affichage.
Comme source de déclenchement on peut choisir un certain mot sélectionné dans le flot de données à l'entrée (déclenchement interne), un signal appliqué en externe ou manuel.

Déclenchement INTerne

Le déclenchement a lieu si un certain mot de déclenchement préréglé est reconnu dans le flot des données (enfoncer le bouton INT).
Ce mot de déclenchement consiste en une combinaison d'uns et de zéros, à sélectionner par commutateurs situés au-dessu des connecteurs d'entrée des données.
Pour les voies d'entrée non-utilisées ou dont l'information n'est pas significative, choisir la position "X" (indifférent) du commutateur correspondant.
Le déclenchement interne peut être combiné avec le retard au déclenchement et le qualificateur de mot (voir fig. 2.3.2.).

Déclenchement EXTerne

Le déclenchement a lieu par un signal externe (sélection sur un front positif ou négatif) appliqué au connecteur de déclenchement sur le panneau avant (enfoncer un des boutons EXT). Voir fig. 2.3.2.
Le déclenchement externe peut être combiné avec le retard au déclenchement.

Déclenchement MANuel

Le déclenchement a lieu en enfonçant le bouton MAN; cette commande prime sur toutes les autres conditions de déclenchement (y compris le retard au déclenchement). Le déclenchement manuel est utile à l'affichage de données capturées, même si le mot de déclenchement est inconnu ou introuvable.

Retard au déclenchement

Le retard au déclenchement est enclenché en enfonçant le bouton ON. Le retard au déclenchement consiste en un certain nombre d'impulsions d'horloge s'écoulant entre l'apparition du mot de déclenchement (ou du signal externe) et le moment réel de déclenchement (voir fig. 2.3.3.).
Lors de la mise sous tension le retard au déclenchement est automatiquement réglé sur 504; ceci signifie que la mémoire est entièrement rafraîchie par les données suivant immédiatement le mot de déclenchement (ou le signal de déclenchement).

La valeur du retard au déclenchement peut être réglée entre 0 et 9999 à l'aide de la commande rotative TRIG DELAY (en position STOP cette valeur reste stable) et affichée dans l'en-tête.

Si le retard au déclenchement est mis hors service (remettre le bouton ON) ou réglé sur 0, le déclenchement a lieu au moment où le mot de déclenchement est présent aux entrées. Dans ce cas, la mémoire contient des données apparaissant immédiatement avant le mot de déclenchement (ou le signal de déclenchement).

La pagination automatique sur tout le programme peut être obtenue comme suit:

— Sélectionner le mode de démarrage AUTO avec un temps d'affichage de 5 secondes par example.
— Régler TRIG DELAY de sorte que le retard au déclenchement croisse (décroisse) d'environ 10 toutes les 5 secondes.

De cette façon un flot continu est obtenu à travers le programme du système sous test.

Qualificateur de mot

Le qualificateur de mot sert comme signal conditionnel supplémentaire pour le mot de déclenchement interne sélectionné et peut être choisi à l'aide des commutateurs TRIGGER QUAL 1 ou 0.
Cette entrée a les mêmes paramètres que les entrées de données en mode capture de parasites et peut servir de 17ème voie pour reconnaissance d'un mot de déclenchement.

Le qualificateur de mot permet une acquisition de données plus sélective en ajoutant au signal de déclenchement une condition supplémentaire (''1'' ou ''0''). Si l'on connecte la sonde d'extension de déclenchement PM 8810 à cette entrée, on obtient une extension de la capacité de sélection de déclenchement.

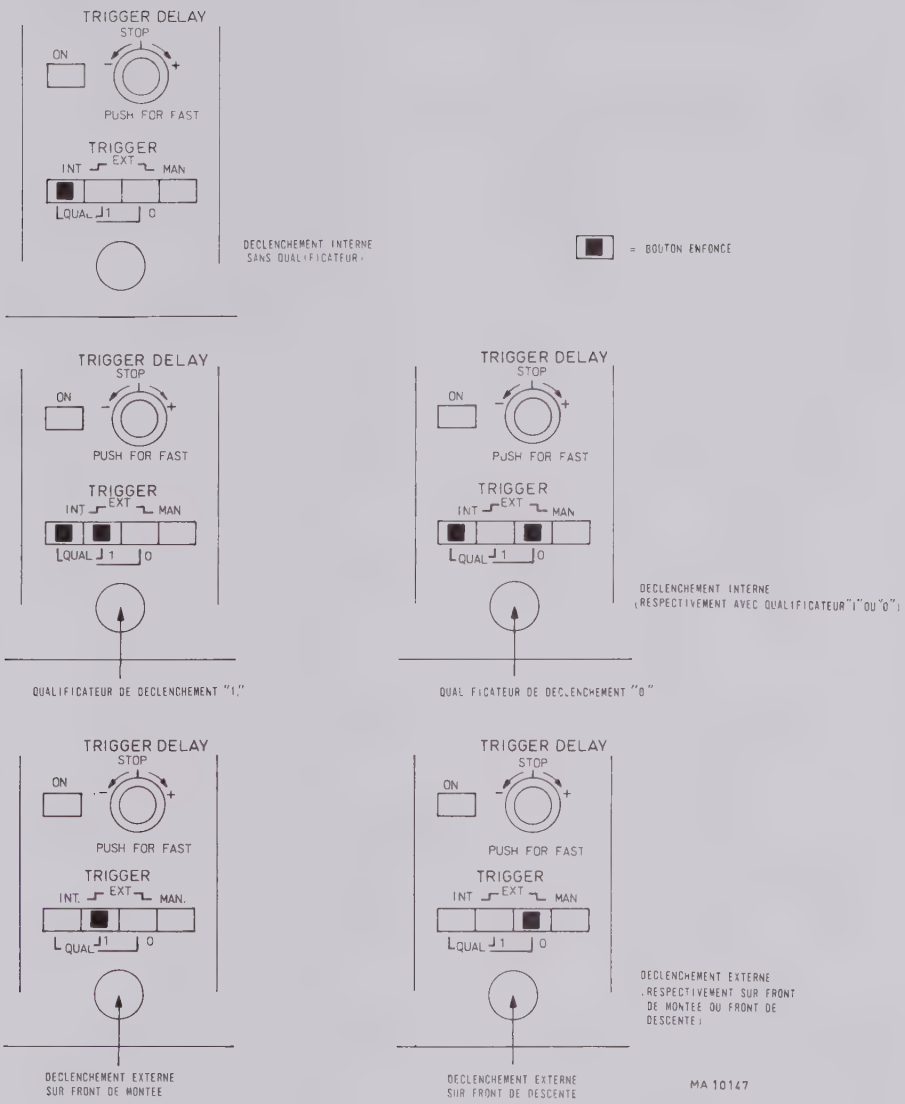


Fig. 2.3.2. Commandes de déclenchement

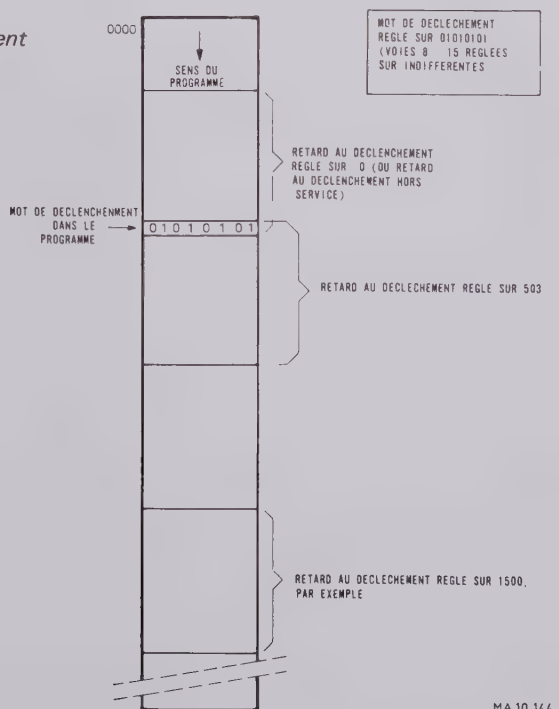

0000
SENS DU PROGRAMME
MOT DE DECLECHEMENT REGLE SUR 01010101 (VOIES 8 15 REGLEES SUR INDIFFERENTES
RETARD AU DECLENCHEMENT REGLE SUR 0 (OU RETARD AU DECLENCHEMENT HORS SERVICE)
MOT DE DECLENCHENMENT DANS LE PROGRAMME
01010101
RETARD AU DECLECHEMENT REGLE SUR 503
RETARD AU DECLECHEMENT REGLE SUR 1500, PAR EXEMPLE
MA 10 144

Fig. 2.3.3. Retard au déclenchement

Curseur

Le curseur est une partie de 16 mots (réglable) de la mémoire.
Le premier mot du curseur est le mot curseur.

En mode TIME, le curseur est la partie intensifiée du diagramme des temps. La position du curseur par rapport au mot de déclenchement sélectionné (ou signal de déclenchement) est indiquée dans l'en-tête de l'affichage.
En mode TABLE le contenu complet du curseur est affiché. Le premier mot de la table est le mot de curseur.

En mode MAP le point correspondant au mot de curseur est compris dans un signe 0.
La position du mot de curseur par rapport au mot de déclenchement sélectionné (ou signal de déclenchement) est indiquée dans l'en-tête de l'affichage.

Le curseur peut être déplacé par échelons, de façon continue ou rapide à travers la mémoire.
Si le bouton CURSOR + ou — est enfoncé pendant un court instant, le curseur ne se déplace que d'un mot dans la mémoire. Si le bouton FAST est enfoncé en même temps, la vitesse de décalage est accrue.
Le curseur peut être positionné partout dans la mémoire et donc servir au déroulement du programme (flot de données capturées).

En fait, le curseur sert à la visualisation de données ainsi que de référence lorsqu'on passe de la représentation sous forme de diagramme des temps vers la représentation sous forme du tableau.

Effacement

La fonction d'effacement sert à sélectionner le nombre de voies d'entrées à afficher sur l'écran.
A noter que la fonction d'effacement n'exerce aucune influence sur l'acquisition de données ni sur la sélection du mot de déclenchement.

En mode TIME les voies restantes sont regroupées en unités de 4 voies sur l'affichage total.

En mode TABLE l'effacement "+" consiste en la suppression des colonnes de gauche (voie 15) à droite (voie 0); les voies effacées sont effectivement remplacées par des zéros dans les tables HEX et OCT.

En mode MAP l'effacement "+" réduit les coordonnées de la carte en échelons (8 x 9, 7 x 8, 7 x 7, 6 x 7, etc.). Cependant, la surface totale de l'écran est conservée, indépendamment du nombre de voies sélectionnées.

Affichage

Le tube cathodique affiche les différent signaux et un texte explicatif (en-tête) en fonction du mode d'affichage et du mode d'analyse.

On distingue trois groupes d'affichage principaux.

Diagramme des temps

Lorsque le bouton TIME est enfoncé, les signaux logiques sont visualisés par rapport à un axe des temps horizontal, de sorte que les rapports de temps entre les signaux est bien visible.
Pour utiliser efficacement le diagramme des temps, il faut appliquer une fréquence d'horloge 5 à 10 fois plus élevée que celle du système sous test.
Enfoncer le bouton CLOCK INT. Cette fréquence peut être sélectionnée à l'aide du commutateur rotatif SAMPLE INTERVAL.
Comme il n'y a pas de relation directe entre l'horloge du système sous test et l'horloge d'échantillonnage de l'analyseur, on parle d' "horloge asynchrone".

Les intervalles d'échantillonnage sont indiqués par les tops d'horloge. Aux niveaux "0" les tops d'horloge sont positifs, aux niveau "1" négatifs. Voir fig. 2.3.4.

En mode TIME l'axe des temps peut être étalé en enfonçant le bouton EXPAND. Les taux de grossissement sont successivement de x1, x10 et x25. En mode x10 et x25 le mot curseur est le premier mot du diagramme des temps.

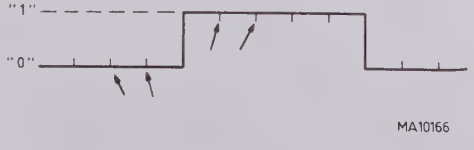


Fig. 2.3.4. Tops d'horloge

En mode TIME l'en-tête montre:

- le taux de grossissement
- le retard au déclenchement sélectionné
- la position du mot curseur par rapport au mot de déclenchement
- le contenu du mot curseur, en hexadécimal, octal ou binaire (en fonction du bouton sélectionné HEX, OCT, BIN).

Chaque voie de données est identifiée par un numéro à gauche sur l'affichage.

Représentation sous forme de tableau

La présentation des données a lieu en caractères (après avoir enfoncé un des boutons HEX, OCT ou BIN), les mots de données parallèles étant représenté dans le plan horizontal; l'ordre est de haut en bas.

Ce mode est très utile pour des analyses en mode synchrone.

L'affichage montre le contenu entier du curseur (le premier mot est le mot curseur).

En mode TABLE l'en-tête montre:

- le mode de présentation sélectionné
- le retard au déclenchement sélectionné
- l'indication des voies sélectionnées.

Chaque mot de données est identifié à l'aide de son addresse par rapport au mot de déclenchement.

Représentation cartographique

Après avoir enfoncé le bouton MAP, les mots de données sont convertis en coordonnées représentées par des points sur l'écran.
Chaque mot a sa position spécifique sur l'écran.
La moitié la moins significative du mot est rapportée le long de l'axe des X (horizontal) et la moitié la plus significative le long de l'axe des Y (vertical).
L'image obtenue représente l'ensemble des données capturées.

Le point correspondant au mot curseur est compris dans un signe 0.

Des points les plus répetés sont de luminosité supérieure, ce qui permet de les reconnaître aisément.

Lorsque des voies sont effacées, le nombre de voies restant est divisé de façon égale sur les axes (X et Y), de sorte que la surface toute entière de l'écran est conservée.

En mode MAP l'en-tête montre:

- le mode de présentation sélectionné
- le retard au déclenchement sélectionné
- la position du mot curseur par rapport au mot de déclenchement
- le contenu du mot curseur, en hexadécimal, octal ou binaire selon le bouton appuyé (HEX, OCT ou BIN).

Les voies utilisées sont affichées à gauche de l'écran ainsi que leur sens sur l'image.

Modes analyseur

On distingue deux modes: SAMPLE et CAPTURE.

Chacun de ces modes peut être combiné avec la fonction COMPARE ou non.
Pour les modes d'échantillonnage et de capture, voir fig. 2.3.5.

Echantillonnage

Il s'agit du mode analyseur de base pendant lequel des données sont prises à chaque front d'horloge (enfoncer le bouton SAMPLE).
L'admission de données peut être synchrone (signal d'horloge appartenant au système sous test) ou asynchrone (avec générateur d'horloge interne).

L'admission de données commence par la fonction START et est arrêtée par TRIG. Les données stockées dans la mémoire d'analyseur peuvent être affichées en mode TIME, TABLE ou MAP.

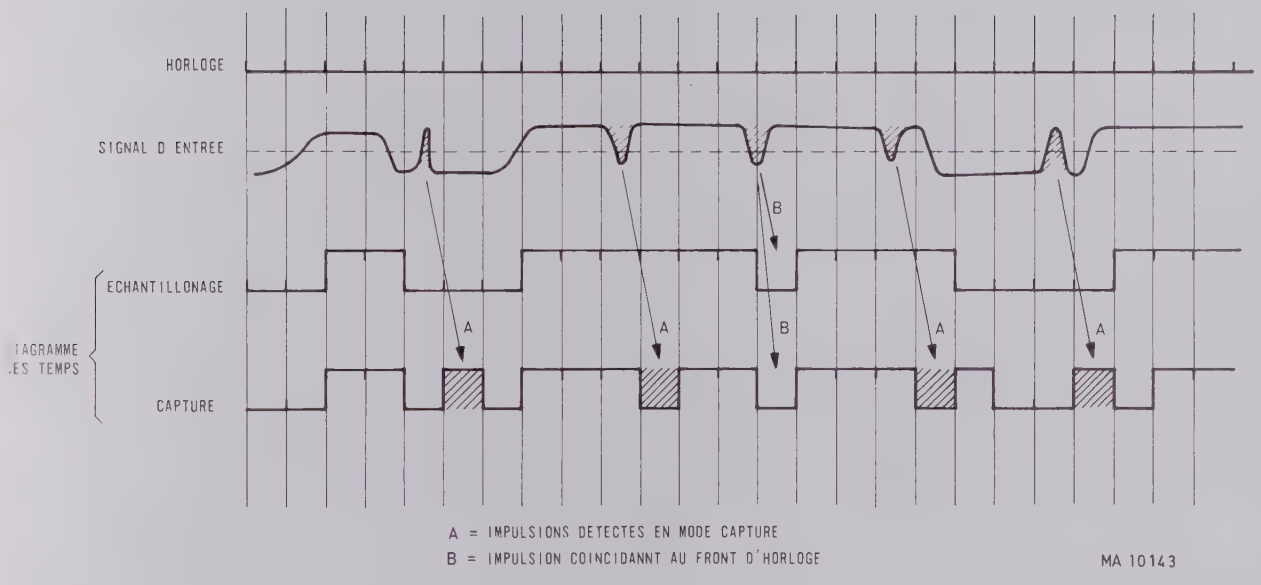
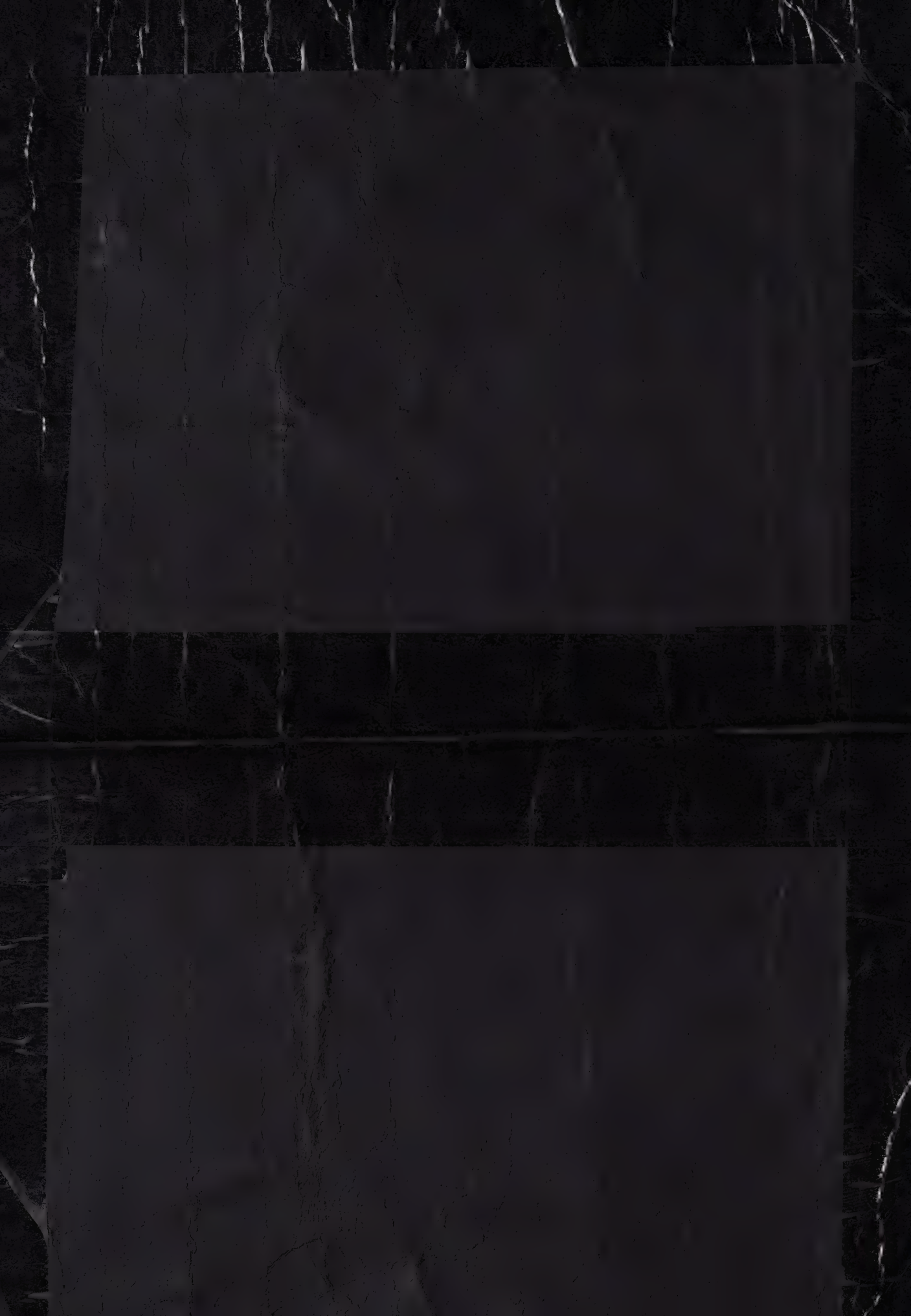


Fig. 2.3.5. Modes d'échantillonage et de capture.



Comparaison

Lorsqu'on enfonce le bouton COMPARE deux flots de données sont comparés.
La mémoire de l'analyseur est alors divisé en deux parties (248 mots chacune).
Une partie représente les données capturées et mises en mémoire, l'autre partie étant la table de référence affichée à côté des données capturées.
Le mode de comparaison est principalement destiné à être combiné avec le mode TABLE.
Si l'on veut utiliser la capacité totale de mémoire pour capturer des données apparaissant juste après le mot de déclenchement, un retard au déclenchement est 247 est requis. La mémoire de référence est remplies de données en enfonçant le bouton STORE REF (il s'agit d'une fonction de démarrage); dès que la condition de déclenchement est présente, la table de référence est affichée.
La table de contenu mémoire est obtenue à l'aide des fonctions de démarrage et de déclenchement standard.

Une différence entre les deux blocs de données est reconnaissable par intensification des caractères dans la table de travail.
Le message intensifié UNEQ est affiché dans l'en-tête si au moins un bit est différent dans la mémoire.

En mode COMPARE l'en-tête affiche:

- le mode de présentation sélectionné
- le retard de déclenchement sélectionné
  - EQ si les deux blocs sont identiques;
  - UNEQ si un bit au moins est différent.

Pour ne plus être en mode COMPARE, il faut à nouveau appuyer sur le bouton COMPARE.

Recherche automatique

Le mode de recherche automatique est un mode de comparaison automatique très utile pour enregistrer des données variant de façon accidentelle.
Les données de référence sont acquises comme décrit sous COMPARE.
Si le bouton SEARCH est enfoncé, seul l'en-tête est affiché. Dans ce cas, le bouton de démarrage AUTO ne doit pas être enfoncé.
Si la condition de déclenchement pour la table des données actuelles est trouvée, le nombre de recherches effectuées est indiqué et les deux tables sont comparées. S'il n'y a pas de différence l'appareil se réarme et attend jusqu'à la condition de déclenchement suivante.

En cas de détection d'une erreur entre les données actuelles et les données de référence, la recherche automatique est arrêtée, l'affichage montre deux tables présentées de telle sorte que le premier mot erroné est dans le mot curseur et le bit erroné intensifié. L'appareil est à nouveau en mode comparaison.

Le taux de répétition du mode de recherche automatique est d'environ 10 Hz. Si nécessaire, le signal de sortie START à l'arrière de l'analyseur peut servir à démarrer le programme du système sous test.

En mode SEARCH, si les donnés actuelles sont identiques aux données de référence, l'en-tête affiche:

- HEX, OCT ou BIN TABLE SEARCH et le nombre de recherches effectuées.
  Si inégalité, le retard de déclenchement sélectionné est également affiché dans l'en-tête.

Pour ne plus être en mode SEARCH, il faut à nouveau appuyer sur le bouton COMPARE.

Sorties sur panneau arrière

Voir également fig. 2.3.6.

Sortie de démarrage (START)

Sur cette sortie un signal TTL avec un front positif est disponible au moment du démarrage réel.
Ce signal peut servir à démarrer le programme d'un système sous test synchrone avec l'analyseur.

Sortie de déclenchement (TRIG)

Sur cette sortie un signal ECL avec un front positif est disponible au moment de déclenchement réel +4 impulsions d'horloge (en mode CAPTURE une impulsion de moins). Le retard entre le déclenchement manuel et l'impulsions TRIG, est imprévisible mais 10 impulsions au maximum.

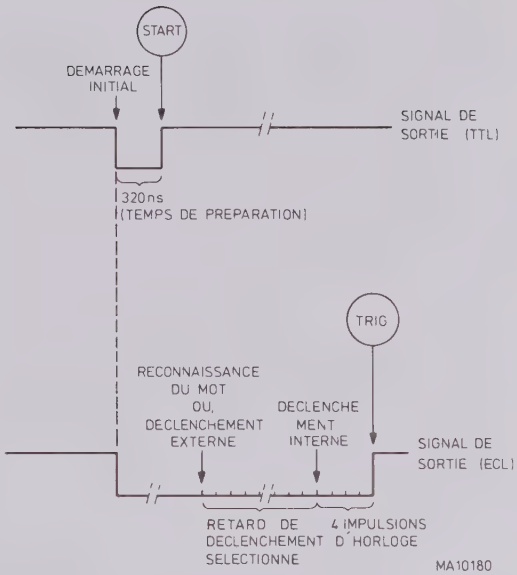


Fig. 2.3.6. Sorties Start et Trig.

Remarque:

En principe, les données suivantes sont d'application à l'emploi d'un analyseur logique, à condition que le retard de déclenchement soit plus petit que la profondeur de mémoire (ou que le retard de déclenchement soit mis hors service).

Si le nombre de mots (échantillons d'entrée) entre le moment de démarrage et la reconnaissance du mot de déclenchement + retard de déclenchement est plus petit que la profondeur de mémoire, l'aire de mémoire précédent le mot de déclenchement ne sera pas entièrement rafraîchie par des nouvelles données.
Comme il n'y a pas de rapport de temps entre le temps de démarrage (démarrage manuel, démarrage automatique ou recherche) et le déclenchement, le nombre d'échantillons d'entrée séparant le moment de démarrage du déclenchement est imprévisible (le mot de déclenchement peut apparaître immédiatement après le moment de démarrage, de sorte que sans le retard de déclenchement, seul le mot de déclenchement se trouve dans la mémoire).

Pour obtenir des courants de données de longueur égale après le moment de démarrage, le signal START-out de l'analyseur peut servir à démarrer le système testé, ou un signal de démarrage provenant du système testé peut être appliqué à l'entrée EXT. START (démarrage externe) de l'analyseur.
De cette façon le nombre d'échantillons séparant le moment de démarrage du déclenchement est prévisible. Cette méthode est très util en mode SEARCH (recherche).

Dans le PM 3500, à chaque démarrage, tout les données en mémoire sont effacées (on ne voit que des 1), mais les circuits d'entrée fournissant les signaux d'entrée à la mémoire ne sont pas effacés. Un affiche (fig. 2.3.7) illustre ceci. Dans cette figure, les trois mots du dessus (FFFF) représentent une partie de mémoire qui n'est pas rafraîchie du tout par des données d'entrée.

Le groupe de mots suivant n'est pas valable, car il provient du circuit d'entrée de la mesure précédente. Ce groupe comporte 12 échantillons au maximum.
Le groupe restant constitue les données réelles.

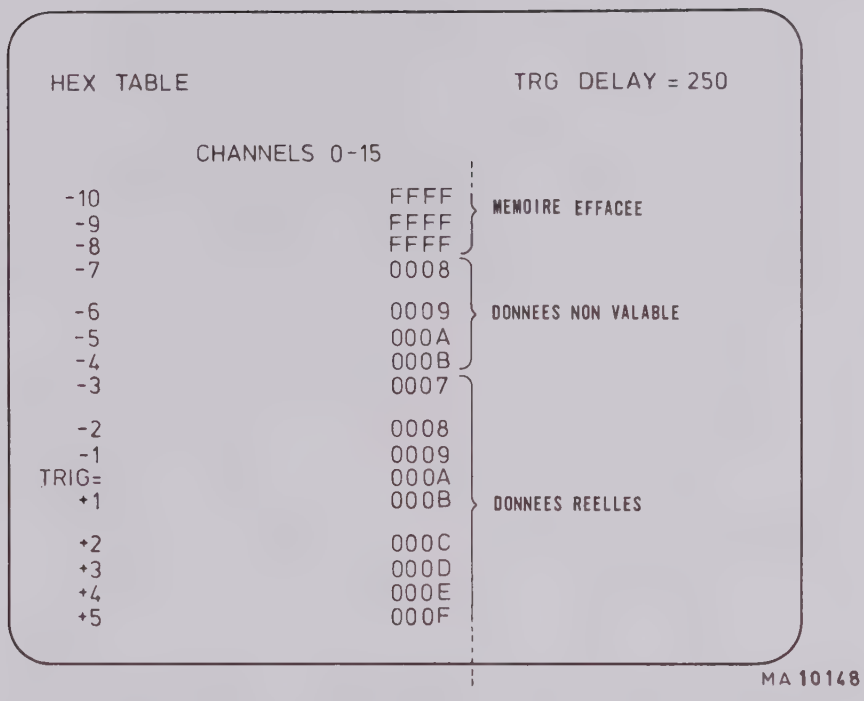


Fig. 2.3.7. Données non-valables

Un nombre de données valables peut apparaître sur l'affichage avant les données réelles, à condition que le retard de déclenchement soit plus petit que la profondeur de mémoire.

2.4. MAINTENANCE

La pratique a trouvé que l'appareil fonctionne dans les limites specifiées pendant une period de 1500 heures de travaille, ou de neuf mois en cas d'usage irrégulier. Cependant, pour garantir le fonctionnement fiable et sans défaillances, l'appareil ne peut pas être exposé à l'humidité,la chaleur, des éléments corrosifs ou la Poussière excessive.

Il se peut que le couvercle et la tôle de fond avec revêtement Nextel se détériorent au bout d'un certain temps. Pour le nettoyage, utiliser un chiffon doux légèrement enduit d'éthanol ou d'un détergent commun. Les chiffons abrasifs ne peuvent pas être utilisés, car ils griffent les surfaces.

ATTENTION: Le revêtement suède Nextel résiste à l'éthanol, mais pas à l'alcool à brûler lequel attaque la surface (suite à la décomposition d'une des substances).

Nettoyage des panneaux avant et arrière et de la plaque de contraste du tube cathodique, ne pas employer de solutions chimiques telles que le trichloréthylène ou l'acétone. Utiliser un chiffon doux de laine ou de coton légèrement imbibé d'eau et d'un produit de nettoyage commun ou enocre d'un peut d'alcool ou de "white spirit".

Après une certaine période, vérifier si les ouvertures dans les plaques du coffret ne sont pas recouvertes de poussière. Si c'est dégager les trous à l'air comprimé.

Fig. 2.4. Dépose de la visière TRC

100MHz LOGIC ANALYZER PM3500

(9450 035 00001)

Service manual

PHILIPS

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General

From PM 3500/02 version on, the internal clock frequency is 100 MHz maximum. This present service documentation applies to versions PM 3500/02 . . . /05.
The difference between a 50 MHz and a 100 MHz PM 3500 is a different input and clock-trigger unit.

Due to supply problems the character generator on the microprocessor unit has been changed from PM 3500/03 onwards (this includes a different service code number for the unit).
Both units however are interchangable.

More modifications realized with the /02 version are :

- Threshold levels for EXT TRIG/TRIG QUAL and CLOCK QUAL inputs can be each set to TTL, separately from channels 0 ... 7.
- The control curve of the INTENS knob has been improved by an additional resistor (R1115).
- Some instruments are provided with a 12 pF capacitor between D1344p.3 and gnd, to suppress glitches on the MCLK line (which may cause uncertain programm control).

Note that the last models (approx. 25 pcs) of the -/01 version are already 100 MHz.

The pinnumbering of I.C.'s D107, D108, 158, 207 and D208 in the PM 3500/01 service documentation (9499 505 00111) is incorrect.
For correct numbering refer to Fig. 1 in this service documentation.

1. Circuit description

1.1. INTRODUCTION

. **Main sections**

The main sections (as indicated in fig. 1.1.) of this instrument are:

- 16 identical input channels, each with a 504 bit deep memory.
  At each clock pulse, a sample of the data present at the input is written into the memory.
  As long as the clock is active, data is written into the memory thus overwriting former data.
- Control and clock circuits.
  One of the functions of this block is to stop the clock signal as soon as the trigger condition is valid.
  The content of the memory is then stable and can be displayed.
- Display control.
  This circuit includes a.o. digital to analog convertors and a character generator.
  The circuit enables the various display modes to be displayed on the screen of the c.r.t.
- Micro-processor control circuit.
  This circuit controls the various circuits of the instrument, and consists of a high-speed microprocessor (8X300) with ROM, RAM and I/O parts.

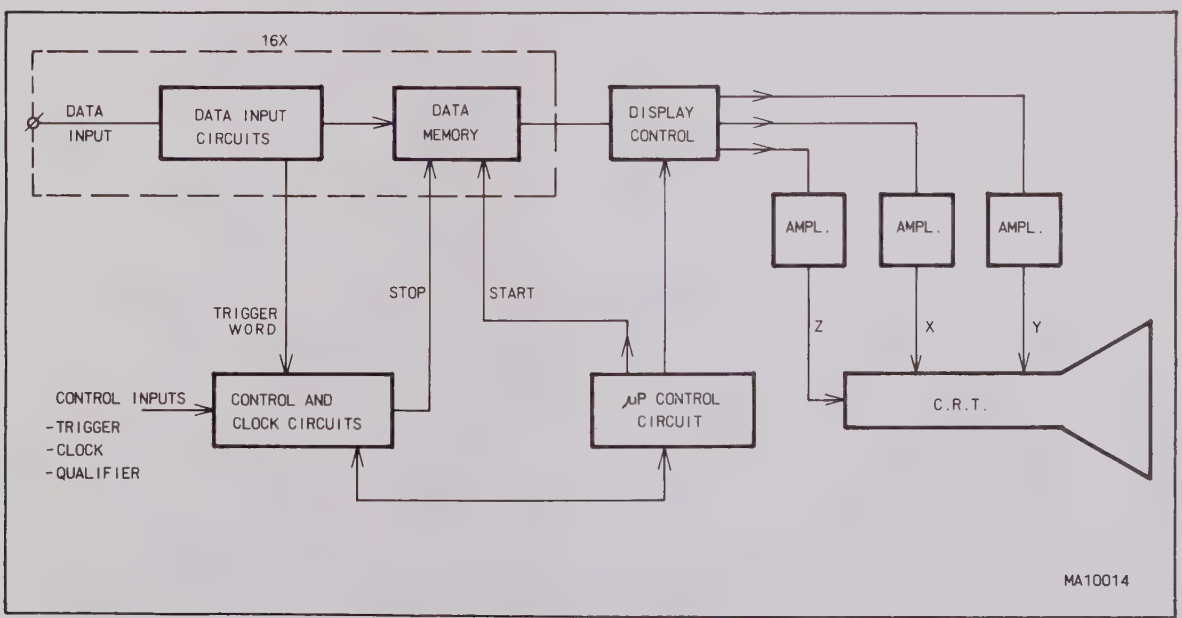


Fig. 1.1. Simplified block diagram

The main working principle (as indicated in fig. 1.2.)

There are two main operational modes:

1. *Memory content display mode.*
   This is in principle a stationary situation which is initiated when all trigger conditions are valid.
   This situation remains as long as no start function is present.

2. *Data intake mode.*
   As soon as a start function is present the instruments starts taking in data and putting this data into memory.
   Data intake is done at the selected clock edges.
   At each data intake, the instrument checks whether the trigger is valid.
   As soon as the trigger is valid, data intake stops, and the memory content is displayed.
   Generally the trigger condition consists of:
   Comparison of the data word which is in the input circuit of the instrument, with the preselected trigger word, and checking whether the trigger delay is zero.
   As long as the trigger delay is not zero, the trigger delay number is decremented at each data intake.
   The display shows "no trigger" as long as:
   – trigger word is not found - or
   – trigger delay not zero.

   Note that in this situation the instrument does not react on most of the front panel switches (also trigger delay cannot be controlled). Only the "MAN" trigger knob directly puts the instrument in the display mode.

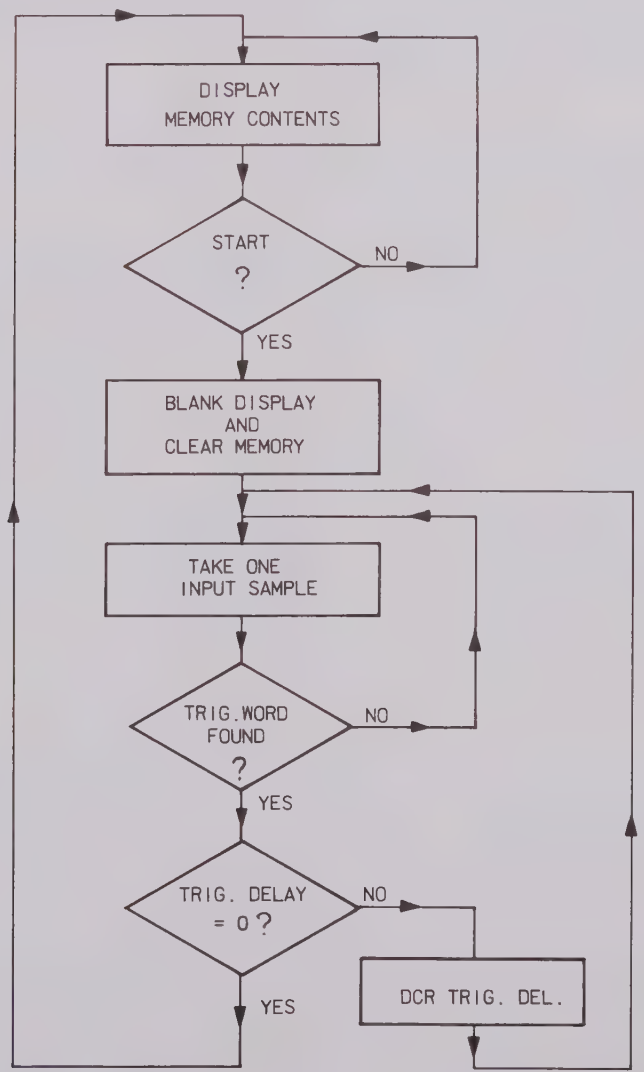


Fig. 1.2. Main working principle

. **Main loop system software**

Refer to fig. 1.3.
After switching-on, the microprocessor carries out the INIT procedure, which includes:

The Power-on test (refer to chapter 3.2.)

The Data memory-clear routine, which sets all "1" 's in the memory.

The setting of several control parameters, such as: Time display-mode; no channels blanked; cursor at start of the memory; trigger delay 503.
Next, the microprocessor checks the position of the Normal/Self-test switch.

The following question is, whether the instrument is taking-in data (RUN), or not.
If the data-intake is running, the instrument checks whether a trigger signal is present or not.
As soon as the trigger is valid the stop routine is carried out, and the data memory contents can be displayed.
If the instrument is not in the run-mode, the micro-processor checks whether the data input action must be started or not. The data input action starts with a memory-clear routine.

Each 1/50 sec. a display routine is executed. The display depends on whether the instrument is in the input mode or not.
In the input mode an error message is displayed: e.g. NO TRIGGER.
If the instrument is not in the input mode the memory content is displayed, under control of the selected display mode switches. In each display routine also the trigger delay value, the margin reference and the heading is displayed.

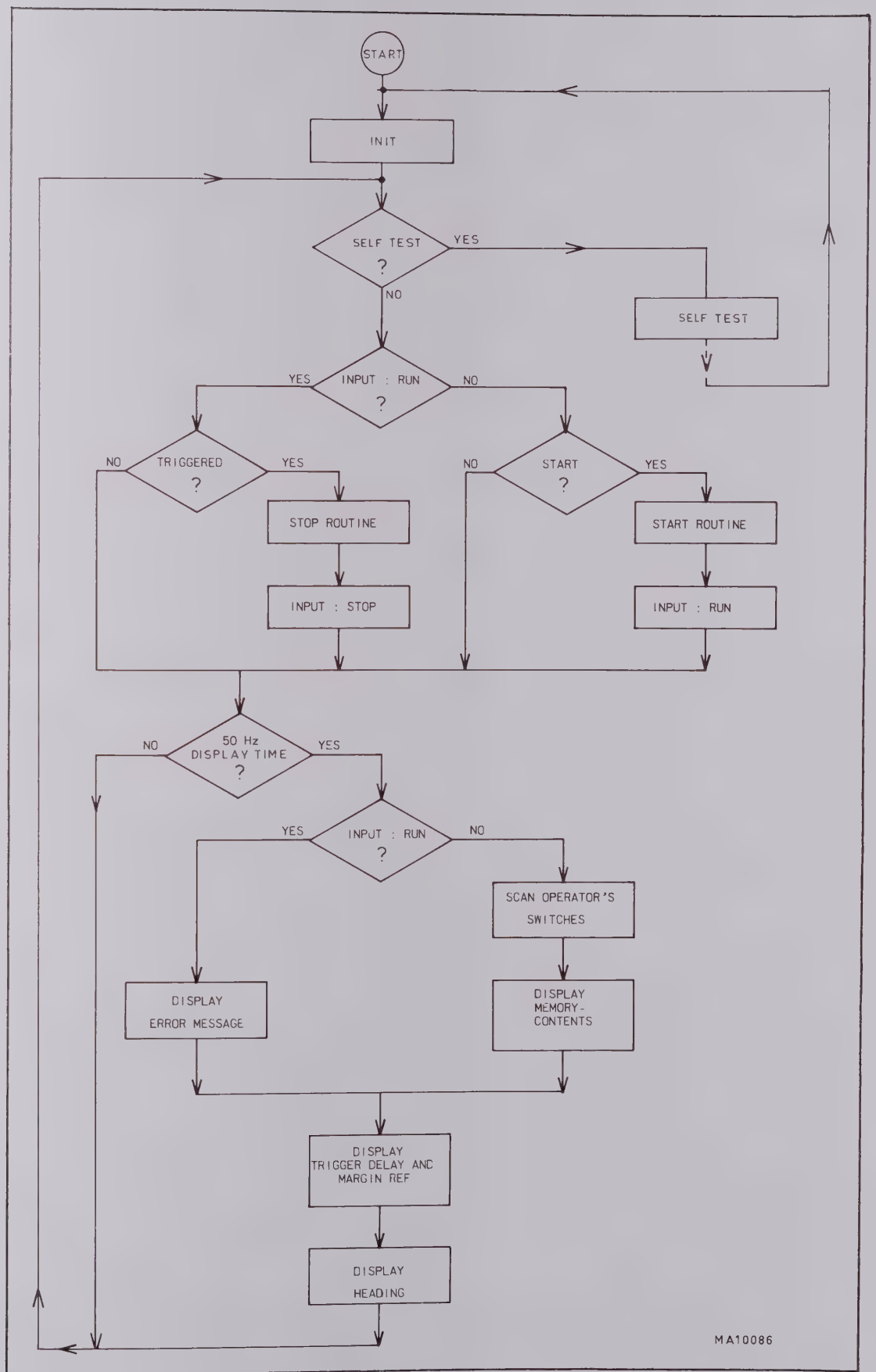


Fig. 1.3. Main loop system software

. **General remarks on the circuit diagrams**

- All push-button switches are shown in the "out" position.
- Type numbers indicated by the Integrated Circuits in the diagrams only give function-indication. For complete type number refer to the parts list.
- Orientational ECL logic input levels applied here are:
  0 V = logic 1
  –2 V = logic 0
  Effective threshold gap: 200 mV

Note: – Open ECL input = logic 0
– ECL has emittor-follower outputs (see fig. 1.4.)

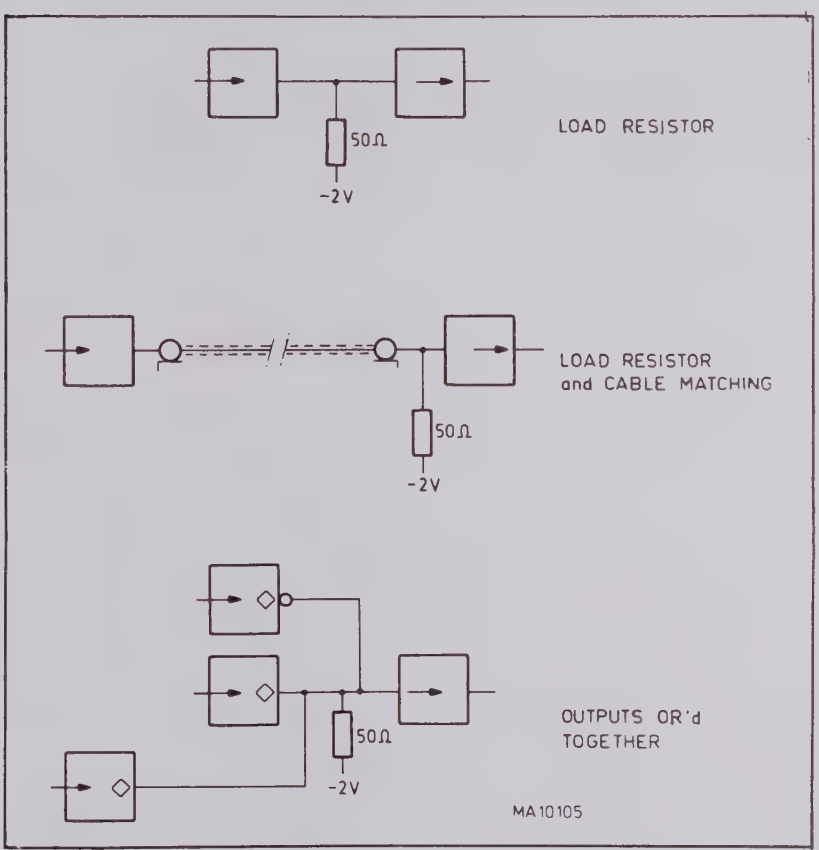


Fig. 1.4. ECL interconnection principles

1.2. INPUT UNIT

. **General**

Refer to: – Circuit diagram Fig. 1
– Input to Memory connections Fig. 2
– Input unit Fig. 3

As all 16 input channels are identical, only 4 channels (ch. 12 ... 15) are given in the circuit diagram and the component lay-out drawing. Note that each group of four channels has a common clock 1 and clock 2 input and a trigger output. Also from each group a 16 wire ribbon cable connects it to the memory unit.

Each input channel comprises:
– An input impedance convertor and logic comparator circuit.
– An input latch, and trigger pick-off circuit.
– An 8-bit serial to 8-bit parallel conversion circuit.

In following description is referred to ch. 15.

. **Input impedance convertor and logic comparator**

The input impedance convertor circuit has been derived from a standard Philips oscilloscope input circuit.

The signal path consists off two parallel ways:
– One for a.c., via C104.
– One for d.c., via D101.

V102, V103 and V104 provide the necessary current amplification. Any possible d.c. drift voltage is compensated by D101 via R117. Preset pot. meter R122 controls the voltage which is the feed-back to D101, thus allowing adjustment of the 100 Hz square-wave response of the input circuit.

The voltage present at the emittor of V104 is compared with the gnd voltage in comparator D102, which delivers an ECL logic signal with a complementary one, to the input latch- and trigger pick-off circuit.

The voltage at the emittor of V104 is also dependant on the threshold-voltage which is applied via R107. This threshold voltage can be controlled by the corresponding knobs on the front panel.

. **Input latch, and trigger pick-off**

This circuit (all ECL logic) takes a sample of the input signal at the clock edge, see fig. 1.5.
Also the glitch-capture facility is in this circuit. (Fig. 1.5. en 1.6.).

In the SAMPLE mode the signal at output p.2 of D102A is latched in D104A at the positive-going edge of clock 1.

One clock period later this signal is latched into D104B. p.15 of D104B is the output of this circuit.

In the CAPTURE mode NOR circuits D103A, B are active, because input p.9 is then logic 0.

In this mode voltage transients (glitches); which are in between two clock pulses (of clock 1) are detected. These glitches are shown on the display during the next sample interval.
The wave forms (fig. 1.6.) explain the working of the circuit in the SAMPLE- and the CAPTURE mode. Note that positive - as well as - negative going glitches are detected. If during one sample interval (i.e. in between two clock moments) more glitches are present, only the first one is detected.

The trigger pick-off circuit is formed by NOR circuits D106A, B and switch S26.
The outputs of D106A and B are "or"-ed together, and "or"-ed with the two outputs of the other three channels. In this way one trigger output point is obtained for four channels (later in the circuit at the clock-trigger unit, these four points are combined again).

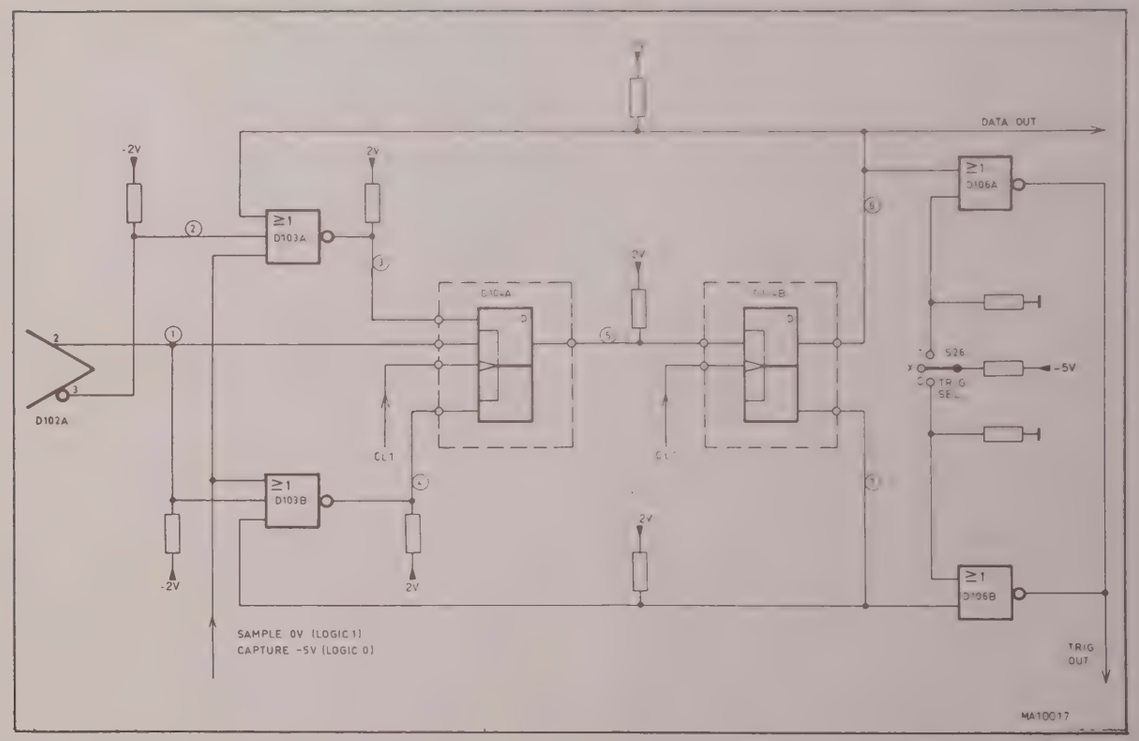


Fig. 1.5. Input latch circuit

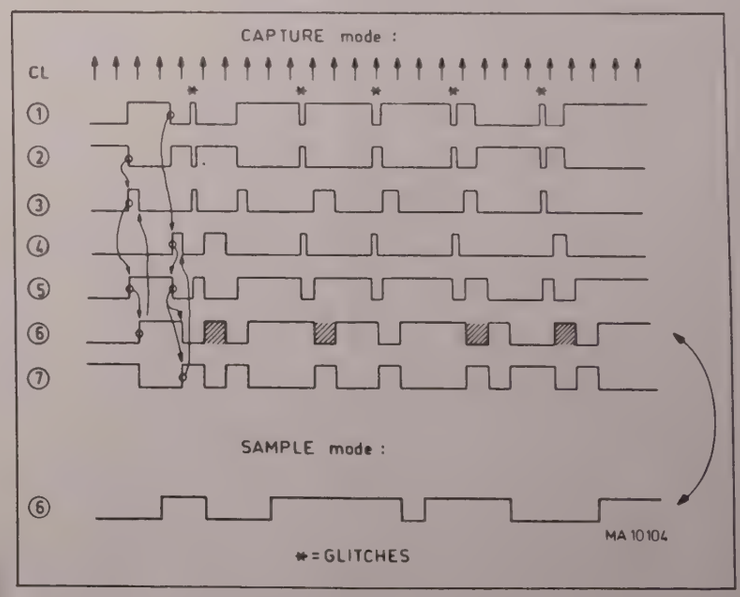


Fig. 1.6. Waveforms in input latch circuit

If S26 is in the "1" position, input p.6 of D106A is logic "0".
In this case a logic "1" on p.7 of D106A makes the output p.3 go to logic "0".
If all trigger outputs are "0" the trigger is valid.
With S26 in the "X" position (don't care) p.6 of D106A, and p.4 of D106B both are logic "1" so that both outputs p.3 and p.2 of D105 are always "0" independent of the input signal of ch. 15.

. **Serial to parallel conversion**

As maximum clock frequency of this instrument is 50 MHz. This would require very fast memory circuits. In order to avoid this problem, conversion of serial to parallel data has been applied, see fig. 1.7.

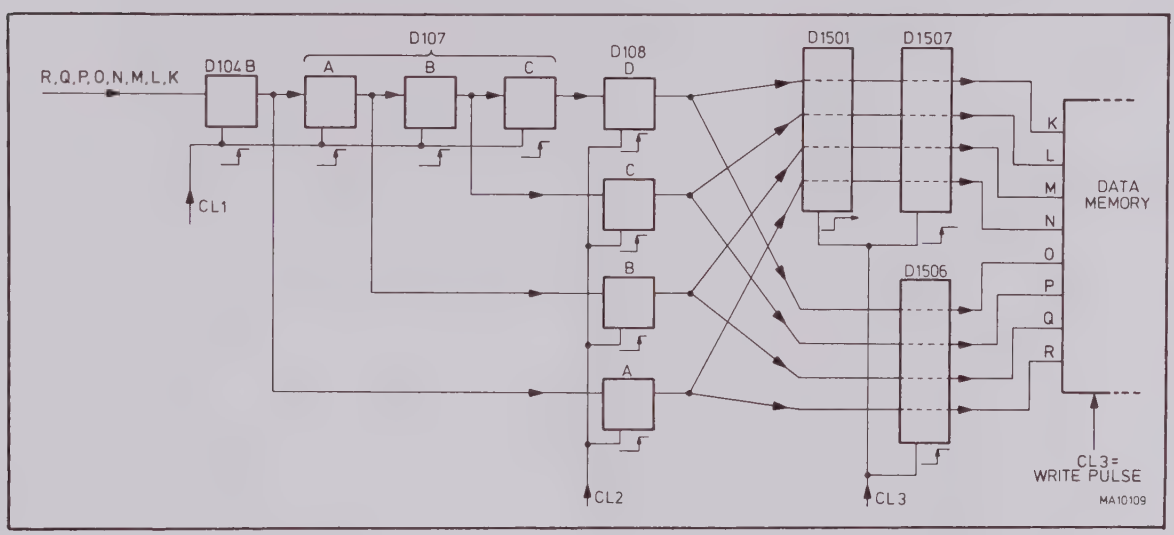


Fig. 1.7. Serial to parallel conversion

Each time eight data samples which follow serial (on one channel), are converted to a 8-bit parallel data word.

The circuits involved are:
– D107 (A, B, C) and D108 (A, B, C, D) on the input unit.
– D1501, 1506, 1507 on the memory unit.

By the interconnection of D107, A, B and C three serial bits are applied in parallel to D108 B, C, D respectively. The next bit is applied to D108A.
The data at the input of D108 is latched into this circuit with clock 2 which is a 1/4 of the frequency of clock 1.

Via an ECL to TTL translator D109 the 4-parallel data bits are applied to the memory unit (conversion of two 4-bits word to one 8-bit word is done on the memory unit).
p.1 of D109 is an ECL threshold reference output (–1,2 V); D109 inverts the bits.

1.3. MEMORY UNIT

Refer to:

- Circuit diagram Fig. 4
- Memory unit Fig. 5
- Circuit diagram selection ch. 0 ... 11 Fig. 6

In the circuit diagram only 4 channels (ch. 12 ... 15) have been drawn (ch. 12 detailed); the remaining ones are identical.
The four bit parallel words coming from the input unit (ch. 15) in clock 2-rhythm are applied to D1504 and D1513.
The outputs of D1513 and D1514 (forming an 8-bit parallel data word) are connected to the write inputs of the RAM circuit D1519.

D1504 is a level sensitive latch, and D1513 and D1514 are edge-triggered flip-flops.
This three circuits are under clock 3 control (clock 3 is a 1/8 of the frequency of clock 1).
Note, that the "0" level of clock-3 is also used as write command ($\overline{WE}$) for the RAM circuit.
For the generation of clock-1, 2 and 3 refer to the description of the clock, trigger unit.

The clear-latches signal is active low during the start action in order to reset the whole data memory content before the next data intake.
The 16 RAM-circuits (D1516, 1517, 1518, 1519 a.s.o.) have common address lines (A0 ... A5), and common data output lines $\overline{O}_0$ ... $\overline{O}_7$.
RAM chip-selection is done by D1521 (D1546, D1571, D1596). These circuits are controled by:
— group selection, which selects one group of four RAM'S;
— channel selection, selecting one RAM in a group.
Each RAM-chip is a 64 words of 9 bits (1 bit not used) read/write memory.

1.4. CLOCK TRIGGER UNIT

. **General**

Refer to :

Clock distribution and memory address counter circuit	Fig.	7a
Trigger combination and delay counter circuit	Fig.	7b
Internal clock divider circuit	Fig.	8
Clock-trigger unit	Fig.	9

This unit locates the following main circuits:
- Inputs for External clock, Clock qualifier, External trigger and Start.
- Divider and distribution circuits for clock 1, clock 2 and clock 3.
- Data memory address counter.
- Trigger delay counter.
- Internal clock generator and dividers.

. **Inputs**

The input circuits for External clock, Clock qualifier and External trigger are provided with the same impedance convertor and comparator circuits as the 16 data channels.
Only the External trigger input is provided with a glitch capture circuit (D911, D912).

External clock input

The signal at the output of the comparator D902 p. 14 is applied to the clock selector D903 (input p. 14).

. **Clock selection circuit**

The external clock signal arriving at the output p. 13 of D902 is either inverted or not, dependant on the level at input p. 15.
If S21 ⌊ has been depressed p. 15 = "1", and the external clock signal is inverted.
If S21 ⌈ has been depressed, the signal is not inverted.
In above mode the internal clock signal (INTCL) generator is blocked, because input p. 11 of D904 is "1".

If S21, INT has been depressed, p. 11 of D904 is "0", and both inputs p. 14 and p. 15 of D903 are "1", so that the INTCL signal is applied and the external clock signal is blocked.
The selected clock signal present at p. 13 of D903 is applied to:

- The clock qualifier circuit (D906).
- The NO CLOCK detection circuit via comparator circuit D909 which acts like a buffer. The NO CLOCK detection circuit is located on the micro-processor unit, refer to chapter 1.5. Control Interface.

. **Clock qualifier circuit**

This circuit, with the dual D latch D906 and the OR-gate D958 (CLOCK ENABLE), combines clock signal, clock qualifier signal and the clock enable signal. Refer to Fig. 1.8.

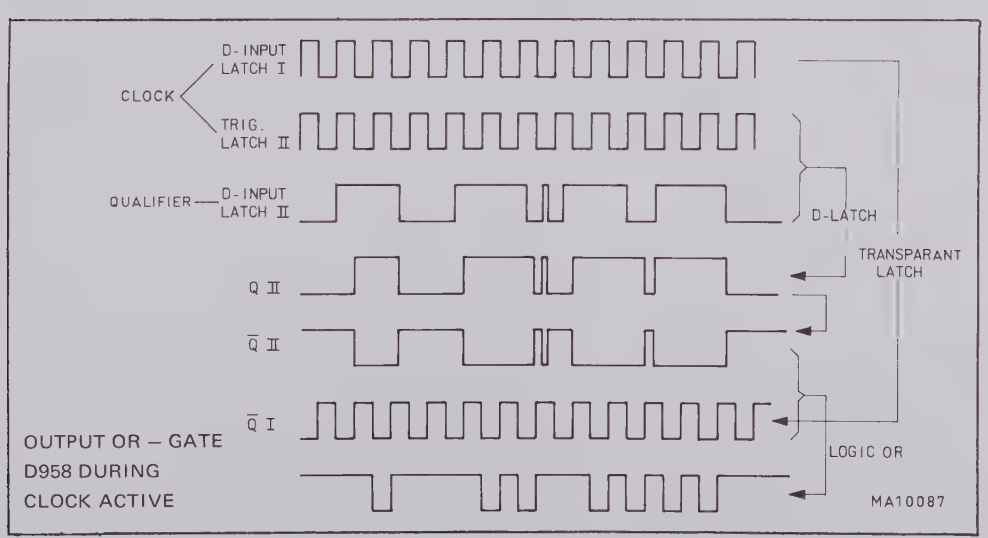


Fig. 1.8. Generation of qualified clock

The clock enable signal is derived from the STRTB signal, which is generated by the microprocessor ($\overline{IVB6}$), and the STOP signal, which appears when all trigger conditions are true. Refer to Fig. 1.9.

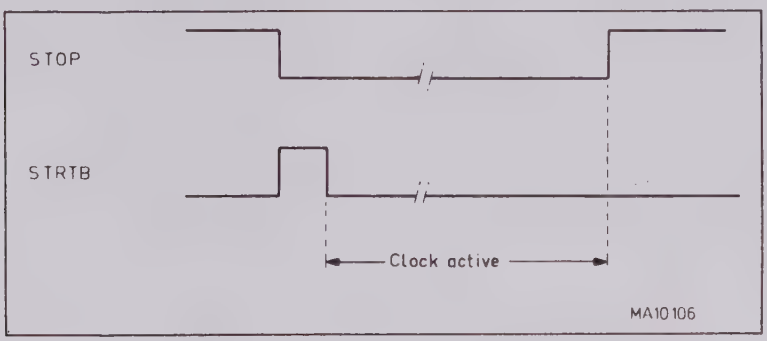


Fig. 1.9. Clock enable

The clock qualifier polarity depends on D903 (output p.10) which acts like an inverter or not, depending on whether S22 "1" or "0" has been depressed. If S22 "X" has been depressed p.10 of D903 is forced to "1".
X910 provides selection of clock qualifier influence on the internal clock (async. clock) or not.
If X910 is short circuited p.10 of D903 is forced to "1", so if S23 Clock Int. has been selected, the qualifier selection or input have no control on the internal clock.
If X910 is interrupted qualifier control on the internal clock is possible.

. **Start switch S24**

The information from these switches is applied to the IV bus via dataselector D938.
The set-reset circuit with D937 is a debounce circuit for S24.

. **Clock 1, 2 and 3**

These signals are used to clock the input signals through the various circuits and into the data memory.
Clock 1 is the qualified internal or external clock.
Clock 2 and clock 3 are derived from clock 1.
Clock 2 = ¼ of the frequency of clock 1.
Clock 3 = 1/8 of the frequency of clock 1.
See fig. 1.10.

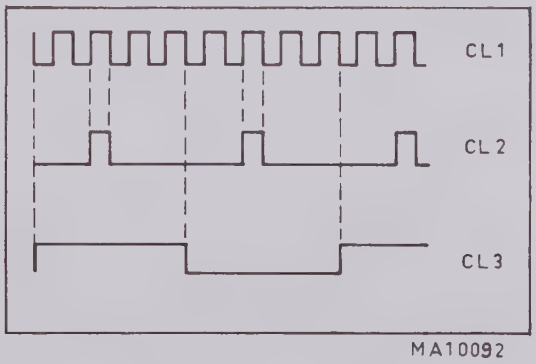


Fig. 1.10. Clock signals

Buffer D921 drives four coaxial cables (0, 1, 2, 3) which apply the clock 1 signal to the input unit.
Buffer D922 drives also four coaxial cables (8, 9, 11, 00) which apply the clock 2 signal to the input unit.
The clock 3 signal deliverd by D941 is applied to the memory unit via four coaxial cables (22, 33, 44 and 55).
The clock 1 (= CL1A, B) and clock 3 signals are also used on the clock trigger unit it self.

Clock 2 and clock 3 are generated with D923 and D924-II as shown in fig. 1.11
The clock 3 signal from D924-II is converted to TTL level with D927.

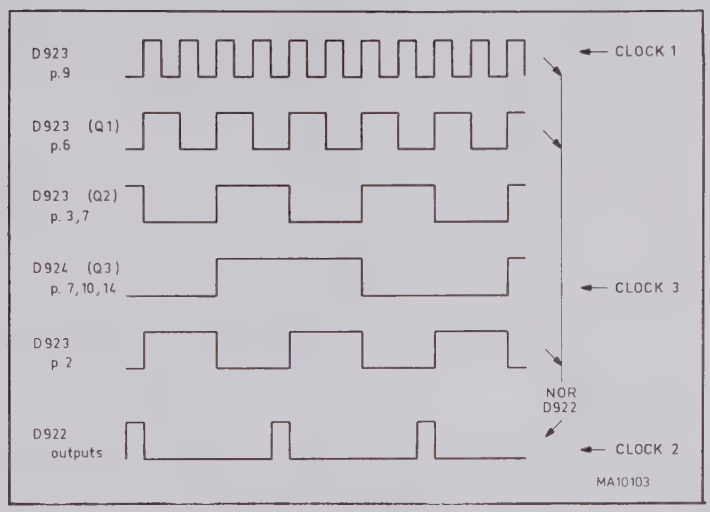


Fig. 1.11. Clock 2 and 3 generation

. **Trigger bit location circuit (D924-I, D926).**

As explained in the data input circuit 8 serial bits at an input are converted to an 8-bit parallel word in the data memory.
The trigger information is (in case of internal triggering) related to one specific bit in a word. The function of the trigger bit location circuit is to memorize the location of the trigger bit.
Latches D924-I and D926 are inactive, as long as the CNTRY signal is not present. The CNTRY signal is generated when the trigger condition is present, and the delay count is passed.

At the moment that the CNTRY signal arrives, the Q1, Q2 and Q3 outputs of the clock generation circuit are latched into D924-I and D926. Via ECL to TTL converter D927, and the data selectors D938, D939, the trigger bit position information is available on the IV bus.

Data memory address counter (D928, D936)

The memory size is nominal 512 bits per channel. As 8 serial bits at the input are converted to an 8 bit parallel word, only 512 : 8 = 64 memory addresses per channel are required. This is done with a 6-bit binary up counter.
Address lines A0 ... 3 are controlled by D928, address lines A4, A5 by D936.
D928 is counting clock 3, the carry from this counter is used to trigger flip-flops D936.
In the compare mode the memory is split-up in two sections. In this case the m.s. bit of this counter (D936 output p. 9) indicates the reference memory, or the trace memory (each 32 addresses nominal). Input p. 6 of D933 is then "1" as a result of which inputs p. 11 and p. 12 of D936 remain "0" and the output p. 9 does not react on clock 3 pulses any more.
The memory address counter is loaded from the IV bus at the $\overline{WR2}$ signal.

. **Triggering**

Introduction

The main sections of the trigger circuit are:
- External trigger input.
- Internal triggering (triggerword recognition).
- Trigger delay counter.
- End-of-cycle detection.

Refer to fig. 1.12.

Triggering is the action that stops the data intake, so that the memory content is available for display. The external trigger signal (together with the selected threshold voltage) is applied to an impedance converter, a comparator and a set of capture flip-flops. These circuits are similar to those in the 16 data input circuits.

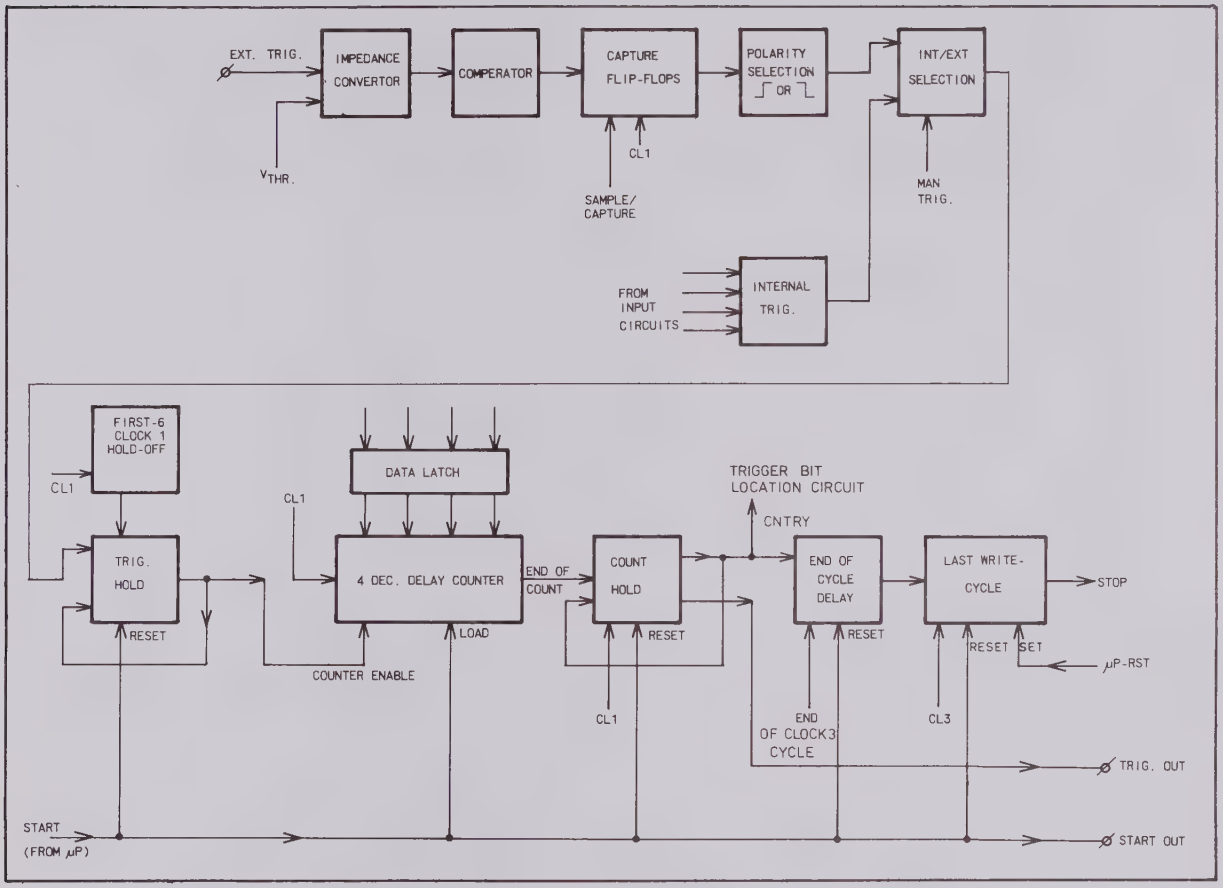


Fig. 1.12. Main sections trigger circuit

After selection of the polarity of the signal (for triggering on the positive- or negative going edge) the circuit is combined with internal triggering and manual triggering.

The next circuit (Trig-Hold) remains in a set condition once the trigger signal has appeared. This circuit is provided with a hold-off circuit for the first six clock 1 pulses, which prevents the circuit from triggering on random data, which may be in the circuit just after starting.
The trig-hold output enables the trigger delay counter which counts clock 1 pulses. This delay counter permits capture of centre-trigger- and post-trigger date streams.
The number of clock 1 pulses (max. 9999) is loaded into this counter from the IV bus via the data latch.
As soon as the delay is elapsed the end of count signal sets the Count Hold Circuit.
The output signal (CNTRY) of this circuit, sets the trigger bit location counter, and drives the End of Cycle Delay latch which is enabled at the end of a clock-3 cycle.

The last circuit (Last Write Cycle) ensures that after triggering, one complete group of 8 serial bits is written into the memory, to be sure that the triggerbit is in the memory.

Finally, the Stop signal is obtained, which stops all clock signals so that no further data intake takes place. The Stop signal is also seen by the microprocessor which then starts the display routine to present the captured data on the c.r.t.

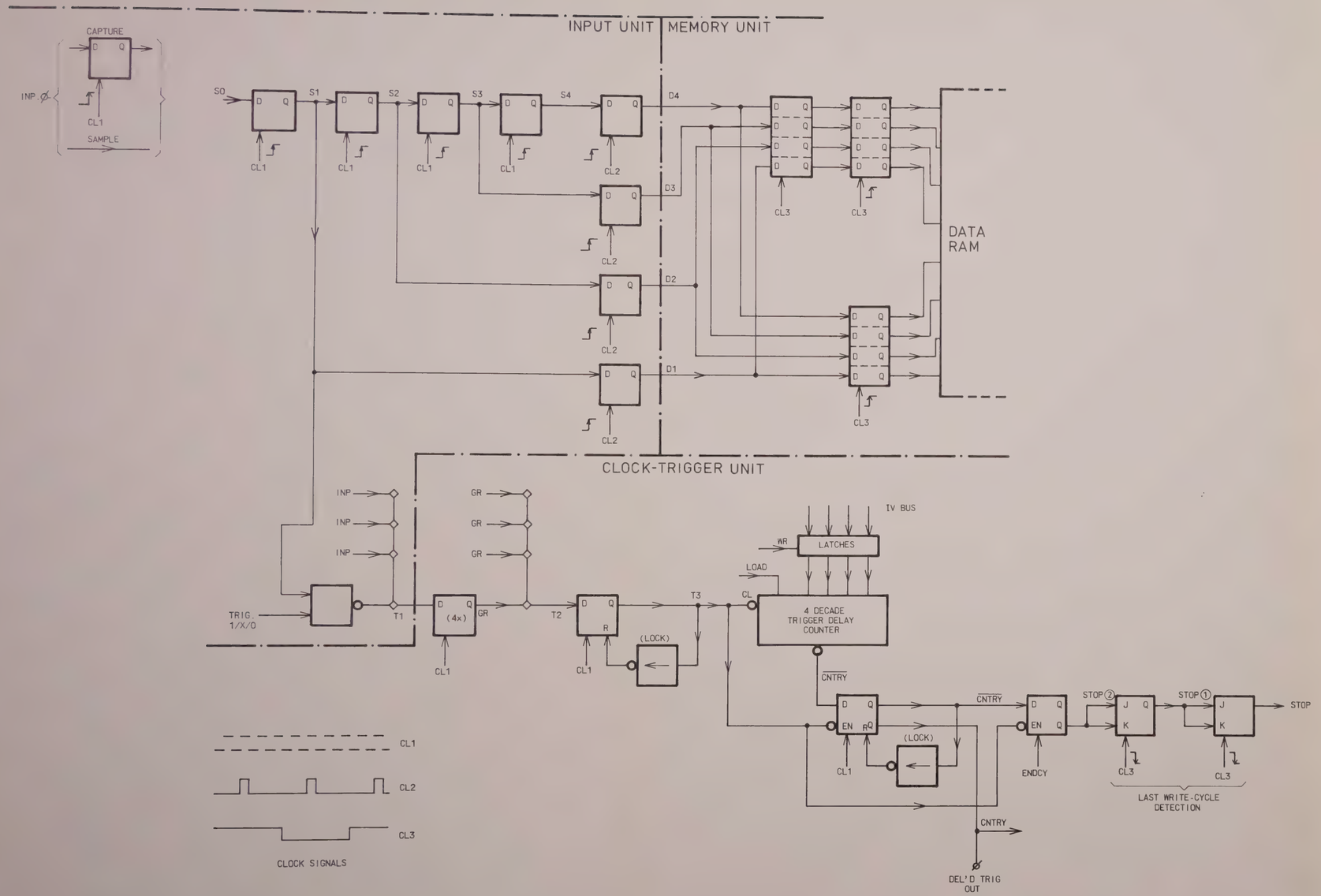


Fig. 1.13.a. Clock control input and trigger circuits

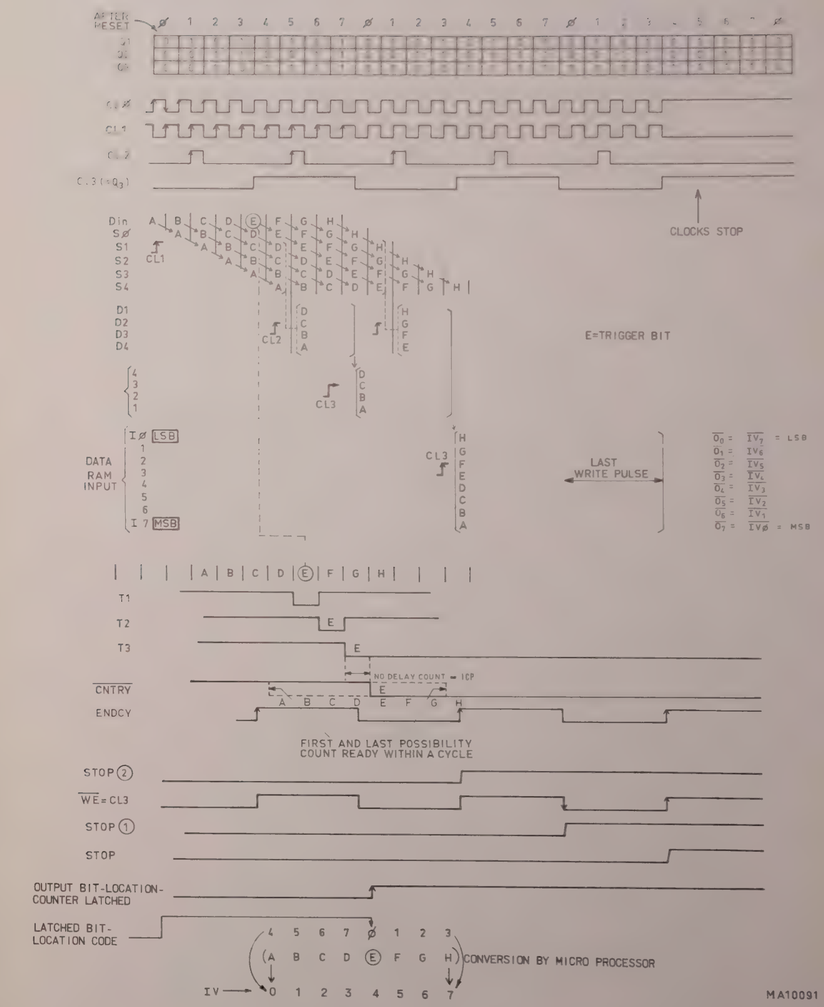


Fig. 1.13.b. Timing of control signals

Trigger circuit timing

Block diagram fig. 1.13a, shows the clock control in the data-input and memory circuits, and the trigger circuit.
Fig. 1.13.b. shows the corresponding timing of the control signals.
Q1, Q2 and Q3 are the count signals of the trigger bit location counter circuit.

A ... H are a group of 8 serial bits, in which E is the selected trigger bit. For example: Internal triggering selected at "1"; all A ... H bits are "0" except E. Just before bits A ... H are written in the memory, the output value of the bit location counter is latched, so that the micro-processor knows the place of the trigger bit in the group of 8 bits.

External trigger input

This input circuit is similar to those of the data input channels. This circuit provides also a "Normal " or "Capture" mode, selectable with the level on inputs p. 11 and p. 14 of D911.

The output signal of the external trigger input circuit is present on input p. 5 of D903, which acts as an inverter or not, depending on the level on input p. 4, thus selecting positive or negative going edges of the input signal for triggering.
Only if Ext. Trig. has been selected (S23, EXT), the reset input p. 13 of D-latch D917 is "0", so that the external trigger signal can pass to D-latch p. 7.
This is a common point where the three trigger signals arrive (external, internal or manual).
The trigger "valid" level on this point is "0".

Internal triggering (triggerword recognition)

On the data input unit, each group of four channels has one trigger output (refer to Input Unit).
On the clock trigger unit these four outputs (coax. cables 4,5,6 and 7) are combined with the aid of D-latches D914 and D916, and arrive on the common point D918 input p.7).
Potentiometers R925, R930, R955, R960 and R975 form glitch suppression filters with the corresponding 39 pF capacitors.
These glitches might occur at high clock frequencies because each output is a combination of outputs of 4 flip flops (refer to the input unit description).
R975 in the ext. trig. circuit to give this circuit the same timing properties as the 4 int. trig. circuits. (generally all 5 potentiometers are in the "0 Ohm" position).

Manual trigger

If switch S23 MAN has been depressed, the reset inputs of D914, D916 and D917 (p. 13) are "1", so that these latches have a "0" output, resulting in a "Trigger valid" at the common point D918 input p. 7.
Depressing S23 MAN also forces the input of D-latch D906-II to "1" (thus neglecting the qualifier condition) and forces a "0" via R1045 to the delay counter circuit thus producing a "counter ready" signal.

Trigger hold-off

At the Start-moment, this is when a new data-intake action is initiated, the logic state of the various flip-flops in the input channels (and trigger input) is uncertain.
This could produce a trigger valid signal on wrong data.
To ensure that the logic circuits are filled with new data a trigger hold-off circuit is present which holds off the trigger detection circuit during the first six clock 1 pulses.
This is D-latch D918 with $\overline{\text{CL3P}}$ signal at input p. 10. This signal is "0" after counting the first six clock 1 pulses.
Output p. 15 of D918 then becomes "0", so that output p.3 of D917 becomes "1" This "1" resets D918 (input p. 13), so that a stable situation is obtained.
The "0" signal of D917 (output p. 2) is applied to the common point D918 input p. 7.

Trigger hold

When all signals at input p. 7 of D918 are "0", output p. 2 of D918 and input p. 7 of D913 become "0".
Because STRTB is "0" during intake data, the "1" at the reset input p. 4 of D918 holds the output p. 2 at "0".
This is the countable signal $\overline{\text{CNTEN}}$ which enables the trigger delay counter.

Trigger delay counter

This circuit counts the clock 1 pulses, which appear after the trigger is valid (= $\overline{\text{CNTEN}}$ is 0).
The counter consists of four decade counters D932 (l.s.b.) and D947, 948, 949.
The counter is working in the 9-complement mode, and is loaded via latches D931, D943,D944 and D946 which are under WR4 and WR5 control.

The counter counts up and gives a ready signal if all decades are 9.
If the trigger delay is switched-off (with the TRIG DELAY ON button on the front panel) the delay counter is pre-loaded with all 9's.

D932 is enabled by the $\overline{\text{CNTEN}}$ signal at input p. 10, and counts the CL1B (= clock 1) pulses at input p. 13.
As output is used the AND function of outputs p. 2 and p. 3 with D951, the output of which (p. 14) is applied to the clock input of the next counter D947 (CNTCL) via an ECL to TTL translator (D956).
The remaining counters are interconnected via the normal carry outputs and clock inputs.

The 9-value of D947, 948, 959, is detected by D953 (output p. 6).
The 9-value of D932 is detected with inverters D952 (inputs p. 5 and 7).
Input p. 10 of D-latch D954 is "0", if all four decades are at 9. At the next clock edge output p. 15 becomes "0", and delivers a positive going TTL edge at the TRIG output at the rear panel of the instrument.
At output p. 14 of D954 appears a "1" (CNTRY) which sets the trigger bit location circuit.
The output of the next D-latch becomes "0" if the ENCY (end of cycle) becomes "1", at the end of the clock-3 cycle.
Via an inverting ECL to TTL conversion section of D956, this signal arrives at two JK flip-flops in series, D957.
These flip-flops trigger on the two opposite clock edges resulting in a delay of one complete clock 3 cycle, being eight clock pulses. This delay is necessary to ensure that data which was in the input circuit at the moment of triggering can be stored in the memory before the STOP action takes place.

The $\overline{\text{UPRST}}$ signal which is "0" for a short moment during power-on routine and if the watch dog circuit is active, also sets the instrument in the STOP situation with the set-inputs of D957.

. **Internal clock oscillator and divide circuits**

This circuit delivers:
- Various clock frequencies, selectable with the SAMPLE INTERVAL switch (SK 18).
- A 6,25 MHz clock frequency signal for the micro-processor (8X300).
- A 50 Hz interrupt signal for the microprocessor to start the display-routine.

All above mentioned signals are derived from a 100 MHz, X-tal controlled, master oscillator formed by one section of D1061.
D1062 and D1063 form a divide -by-5 circuit delivering 20 MHz. This 20 MHz signal is applied to a divide -by-10 chain D1066 ... D1068, which deliver frequencies of 2 MHz, 200 KHz, 20 KHz, 2 KHz and 200 Hz. One of these frequencies is selected by D1069.
D1069 is followed by two divide -by-2 which deliver the 1/2 and the 1/4 of the forementioned frequencies.
The next circuit D1072 can select the output frequency of D1069, or the 1/2, or the 1/4 value of this frequency. In this way the frequencies 50 Hz up to 20 MHz (interval times 20 ms up to 50 ns) are selectable in steps of 1, 2 and 5.
The output of D1072 is via a TTL to ECL matching circuit, applied to the output (INTCL) via a gate of D1061.

The 50 MHz is taken from the 100 MHz via a divide by two, D1064.
The 50 MHz and 100 MHz signals are each applied to the output (INTCL), via a gate of D1061.

For ECL to TTL conversion of the 20 MHz and 25 MHz signals refer to fig. 8 (D956).

- Microprocessor clock.
  The 50 MHz signal is also divided by 8, by one section of D1064 and by D1074, to obtain the 6,25 MHz clock frequency for the microprocessor. The required current-drive is obtained by V 1061 and V 1062.
- 50 Hz display routine interrupt signal.
  This frequency is obtained by a divide -by-4, D1071 which is driven by the 200 Hz output frequency of D1068.
- Signal F100M.
  Transistor V 1063 gives an information to the micro-processor, that the 100 MHz clock frequency has been selected by SK 18. At this frequency a slightly different software action was needed.
  In the –/01 series of this instrument (max. 50 MHz), this circuit is not in use.

1.5. MICROPROCESSOR UNIT

. General

Refer to:

- Circuit diagram micro processor and rom circuits — Fig. 10
- Circuit diagram memory acces, R/W commands and threshold circuits — Fig. 11
- Circuit diagram control interface — Fig. 12
- Circuit diagram X, Y and Z control — Fig. 13
- Micro processor unit — Fig. 14

The micro processor unit contains the following main circuits:

- Microprocessor with system-rom, scratchpad memory and I/O ports.
- Scratchpad memory and input data memory, address selection (access).
- Various auxiliary circuits, such as watchdog for the microprocessor, control of the data input threshold voltages, decoding of read-write command signals and front panel interface circuits.
- Digital to analog signal conversion for X and Y deflection of the cathode ray tube.

. Microprocessor circuit

The microprocessor 8X300 (D1308) was selected because of its high working speed (16-bit instruction decoding and execution time within 300 ns).

The 6,25 MHz clock required for the micro-processor (pins 10 and 11) arrive via two coax cables from the clock-trigger unit. The clock-signal is derived from the 100 MHz master oscillator via some divide circuits (ref. to fig. 9).

Transistor V1301 supplies a regulated voltage (+2,8 V) for the microprocessor.

The microprocessor has three busses:

- A 13-bit address bus (A0 ... A12) used only for addressing the system ROM; A0 is the most significant bit.
- A 16-bit instruction bus (I0 ... I15) used only to fetch the instruction from the system ROM to the microprocessor.
- An 8-bit IV bus ($\overline{IVB0 ...7}$).
  This is the real communication bus, which links the remaining circuitry of the instrument, and can contain addresses or data.
  Note that this bus is active low; $\overline{IVB0}$ is the most significant bit.

  Furthermore the microprocessor is provided with following control outputs:

  - WC = Write Command. If WC = "1", the microprocessor puts data on the IV bus.
  - SC = Select Command. If SC = "1", the microprocessor puts an address on the IV bus.
    If both WC and SC are "0", data is expected on the IV bus for the microprocessor.
  - MCLK = Micro-processor clock-output to control I/O devices.
  - $\overline{LB}$ and $\overline{RB}$ (left- and right bank resp.).
    As the IV bus has 8 bits, up to 256 different addresses could be selected. By means of $\overline{LB}$ and $\overline{RB}$ this number can be doubled.

    The $\overline{LB}$ and $\overline{RB}$ outputs are always opposite. In each bank 256 addresses can be selected.
    (Use of $\overline{LB}$ and $\overline{RB}$ in this system does not mean that more than 256 addresses are required in this system. But once two addresses in different banks have been selected, the micro-processor only needs to switch-over the $\overline{LB}$- and $\overline{RB}$ signals in order to change from one address to another).
    For an survey of IV bus address decoding refer to the table, see page 23.
  - $\overline{HALT}$ input stops the micro-processor after completion of the current instruction.
    In this instrument this $\overline{HALT}$ is not used.

– The RESET input when "0", forces the program counter of the micro-processor to address 0 (being the start address of the system program). This input is active, when the instrument is switched-on (R1322, C1314 and D1312 A, B). Also when the Watch dog circuit is active the $\overline{\text{RESET}}$ input goes to "0" (refer to Control Interface).

– ROM (D1301 ... 1304, 1306, 1307)
All the programs the micro-processor has to carry-out, and the required data are in the ROM. The ROM consists of six I.C.'s labelled A ... F.

Next to the micro-processor and the ROM I.C.'s two 40-pole connectors (X1304, X1305) are located.
They can be used to check the various micro-processor signals.
For pin-identification see fig. 3.4.

– Scratchpad RAM (D1327)
This is a 64 words of 9 bits read/write memory used by the microprocessor (only 8-bit words are used).

IV BUS ADDRESS DECODING

IVBL Number

0 (A7)	1 (A6)	2 (A5)	3 (A4)	4 (A3)	5 (A2)	6 (A1)	7 (A0)	Octal	Read	Write	Remarks
									WC=0	WC=1	
					0	0	1	001			Reads the front-
		0	X	X	0	1	0	002	$\overline{RD3}$		panel switches under
					1	0	0	004			matrix control
0	0	1	X	X	X	X	X	040	$\overline{RD3}$		Reads trigger delay controls
				0	0	0	1	001		WR3	Display control
				0	0	1	0	002		WR4	Trigger delay counter-
		X	X	0	1	0	0	004		WR5	loading L.S.B. - M.S.B. resp.
				1	0	0	0	010		WR6	Clock, trigger control
		0	0	0	0	0	0	100	$\overline{RD2}$	WR2	Data memory address selection
0	1	1	0	0	0	0	0	140	$\overline{RD2}$		Clock, trigger control output
1	0	A5	A4	A3	A2	A1	A0	200 : 277	$\overline{RD1}$	WR1	Scratchpad RAM
				Address selection							
1	1	0	0	A3	A2	A1	A0	300 : 317	$\overline{RD1}$		Data memory channel selection

LEFT BANK

RIGHT BANK

"IV- Bytes"
Internal address decoding

001	(C)	DAC -	Y-deflection
002	(B)	Char. scan + Z control	
003	(D)	Char. address + Timing data	
004	(A)	DAC -	Y deflection

Memory acces, R/W commands and input threshold circuits

Refer to fig. 11.

- Data memory address selection
  D1352 which is controlled by IVBL4 ... 7, controls the channel - and group selection of the data RAM, via the enable-gates D1353, D1354.

- Read/Write commands
  To control the functions of the several circuits of the instrument, a number of Read/Write signals are required. All these signals are under $\overline{LB}$ control.
  The signals are generated with gates D1344, D1345 ... 1349 and D1351, which are under control of the micro-processor control outputs, and signals IVBL0, 1, 4 ... 7.

  ALE
  This is the address latch enable signal which activates latches D1326 and D1327, thus obtaining IVBL 0 ... 7 which are mainly used for address selection of the system-RAM and data-RAM.

  $\overline{RD1}$
  This is the enable signal for data selectors D1328 and D1329.
  These circuits connect the output of the system-RAM or data-RAM to the IV bus (depending on IVBL1).

  $\overline{RD2}$
  This is the enable signal for data-selectors D938 and D939 (on the clock-trigger unit).
  These circuits connect a.o. start- and stop information and data-RAM address counter output to the IV bus.

  $\overline{RD3}$
  This is the enable signal for data-selectors D1331 and D1332, which connect the front-panel knobs and corresponding circuits to the IV bus. See fig. 12

  $\overline{WR1}$
  This signal puts data from the IV bus into the scratchpad-RAM D1327.

  $\overline{WR2}$
  This signal controls D928 and D933, and is used to load the address counter (D928, D936) for the data-RAM addressing with an address from the IV bus. See fig. 7a

  WR3
  This signal activates latches D1323 and D1324, which put data (control word) from the IV bus into the X, Y and Z circuits for the c.r.t. See fig. 13

  WR4
  This signal activates latches D931 and D943, in order to load data from the IV bus into counters D932, D947 which from the least significant part of the trigger delay counter. See fig. 7b

  WR5
  This signal activates latches D944 and D946, in order to load data from the IV bus into counter D948, D949 which from the most significant part of the trigger delay counter. See fig. 7b

  WR6
  This signal activates latch D942, which controls part of the start circuit, and the most significant bit setting of the data memory address selection. See fig. 7a

- Threshold control
  The threshold control circuit provides the d.c. voltages, which are applied to the various input circuits as threshold voltages.
  Note that two different threshold voltages can be selected at the same time; one for ch. 0 ... 7 and clock, qualifier and trigger input and one for ch. 8 ... 15.
  Amplifiers D1366 are used when adjustable threshold voltages have been selected.

  From version -/03 onwards the threshold circuit is provided with jumper threshold selection for ext. trig/trig. qual (X1312) and for the clock qualifier (X1313).
  At delivery these jumpers are set so, that these input threshold levels are the same as set for ch. 0 ... 7.
  In the other position of the jumpers, the levels are TTL independent of the ch. 0 ... 7.

Control interface (fig. 12)
(including Clock detection and Watch dog circuits)

Most of the front panel controls and circuits are read by the micro-processor with the data selectors D1331 and D1332, which connect directly to the IV bus.
Switches S1 ... 5, S9 ... 14 and S15, S16 are matrix selected.

– V.C.O. and Trigger Delay circuits.
These circuits are used to control the presetting of the trigger delay value.
The V.C.O. circuit generates pulses each of which increments or decrements the trigger delay value.
The whole circuit is controlled by the TRIGGER DELAY pot. meter (R4) at the front panel.
If this pot. meter is in the mid-position both inputs p. 7 of D1358A and p. 9 of D1358B are equally high resulting in the output of D1357A low, and the output of D1357B high.
This holds the input 11 of D1358C high, while input p. 10 of D1358C stays low, so that a stable situation is obtained.

As soon as R4 is rotated out of mid-position, the voltage at one of the inputs p. 7 of D1358A or p. 9 of 1358B decreases, so that one of the inputs of D1357A gets "0". Consequently the output of D1357A becomes "1" and the output of D1357B becomes "0".
This decreases voltage on p. 11 of D1358C so, that the output of this amplifier gets "0" and consequently the output of D1357D gets "0", this discharges C1372 via R1417.
As soon as the voltage on C1372 gets lower than the voltage on p. 11 of D1358C the output of this amplifier becomes "1". Consequently C1372 is charged again (via R1407) until the voltage at C1372 exceeds the voltage on p. 11 of D1358C, and C1372 is discharged and so on. The more R4 is rotated out of mid-position, the higher the charge current for C1372, and the higher pulse-rate is generated.
If R4 is rotated far from the mid-position, V1312 starts conducting, thus increasing the pulse-rate even more.
The signal is made symmytrical (and divided by two) with D1356 and consequently applied to input p. 13 of D1331.
D1333A detects the sense of rotation of R4 (D1333A p. 2).

Switch S20 (PUSH FOR FAST) is directly connected to D1331; so the V.C.O. frequency is not dependant on S20.

– Display Time
D1333B is a free-running oscillator, the frequency of which is dependant on R5.
The oscillator frequency is adjustable from 1 Hz to 20 Hz. The micro-processor divides this frequency by ten, thus obtaining display times from 10 sec. to 1/2 sec. respectively.

– Clock Detection
The purpose of this circuit is to indicate whether no clock signal, or a too slow clock signal (less than approx. 50 Hz) is present. The circuit consists of a divide-by-four circuit (D1309) and a monostable retriggerable multivibrator (D1311A).
The input signal is taken from the clock-trigger unit (cable 999), where the internal clock or the external clock signal (not qualified) is present.
As this frequency can be maximum 50 MHz, it is first divided-by-four and then via V1302 (for ECL to TTL conversion) applied to D1311A, which originates a 100 ms pulse after triggering.
As long as positive-going edges with a repetition rate of more than 10 Hz at p. 2 of D1311A are present the output p. 4 remains "0". As soon as the voltage at p. 2 of D1311A remains stable longer than 100 ms, the output p. 4 becomes "1". This generates the NO/SLOW CLOCK information on the display.

– Watch dog circuit
Normally the micro-processor runs a part of the program, depending on several parameters, control knob settings and so on.
The parameters in the scratchpad-RAM have been set in the initializing routine, which is part of the power-on routine.
If for whatever reason, parameter data is changed resulting in a non-practicable combination, the micro-processor might run in a "ghost"-routine. This could result in an abnormal display or no display at all (it might happen that the micro-processor then does not respond to the control functions anymore, and so on).

To prevent this, the watch dog circuit has been applied.
This circuit is under the control of the micro-processor address line A0 (being the MSB address bit).
This line has no addressing function because the ROM-program in this instrument is approx. 3 K.
Somewhere in a frequently appearing display routine is an instruction that only activates A0 for a short time. (Approx. 50 ns). Via D1312C and –D this signal is applied to the monostable retriggerable multivibrator D1311B.
As long as signal edges on input p. 9 of D1311B are present, the output p. 5 will remain high. As a result of this the micro-processor $\overline{\text{RESET}}$ input remains high.
If A0-activity disappears, the output p. 5 of D1311B goes low after approx. 1s.
Assuming that the service-switch is in the Norm-position (system mode), the $\overline{\text{RESET}}$ input then goes low.
This forces the micro-processor to start again at address 0, so that the various parameters are reset correctly. V1306 takes care that $\overline{\text{RESET}}$ does not remain low. As soon as p. 5 of D1311B goes low, V1307 becomes conducting and sinks input p. 10 of D1311B low, thus making p. 5 of D1311 high again.

The $\overline{\text{RESET}}$ signal is also applied to the D957 circuit on the clock-trigger unit, as a result of which the instrument is always in the STOP condition after switching-on.

Note that this watch dog circuit does not work if the service-switch is in the Serv. position (Self test mode).

X. Y. Z Control

This circuit is under $\overline{\text{RB}}$ control, and is provided with four I/O ports, and four digital-to-analog converters (DAC's).
Two DAC's for X- and Y-positioning and two for additional deflection control.

– I/O ports
The input for the X, Y, Z circuits comes from the IV bus, via four bi-directional I/O ports D1316 ... 1319.
In this circuit the I/O ports work as output ports only ($\overline{\text{BIC}}$ = 1, $\overline{\text{BOC}}$ = 0).
Though the ports have the same type number, they have been programmed to different address selection, indicated by the numbering 001 ... 004.
A specific port is selected by putting an address on the IV bus, together with a select command (SC).
Next, data on the IV bus is put in the selected port, with a write command (WC).
The port remains selected until a different address (with SC) appears on the IV bus.

Port selection

		IV bus *)							
Item number	Number	7	6	5	4	3	2	1	0
D1317	001	1	1	1	1	1	1	1	0
D1318	002	1	1	1	1	1	1	0	1
D1319	003	1	1	1	1	1	1	0	0
D1316	004	1	1	1	1	1	0	1	1

**) Note: IV bus is active low.*

– DAC's
Each DAC (D1313, 1314, 1336, 1337) has an 8-bit input and a balanced 0-2mA current-source output.
The nominal output current is dependent on the reference-voltage input.
The reference voltage is made by the D1334 circuit which delivers 7 V.

– X-deflextion
Port D1316 applies 8 parallel bits to DAC D1313, thus obtaining a pre-positioning analog deflection current, which is applied via cables 444 and 555 to the final-X amplifier.
DAC D1336, the output of which is in parallel with the output of DAC D1313, is used to supply additional data required for the X-deflection.

Input p. 7 of D1336 is controlled by the latch D1322 and delivers an X-offset, used to select the general data-field or the marginal field (fig. 1.14.).

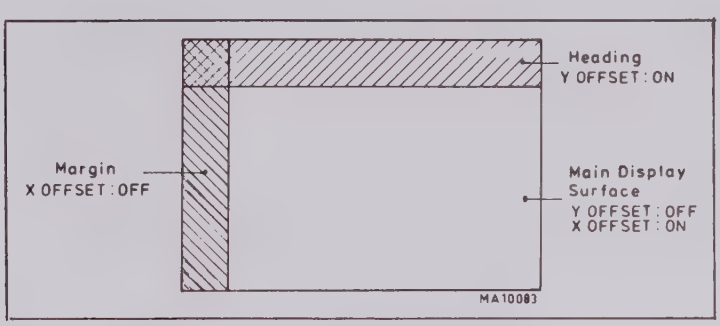


Fig. 1.14. Heading- and margin off sets

Inputs 9, 10 and 11 of D1336 receive column selection information used for character presentation. Inputs 10, 11 and 12 of D1336 receive an X-fine deflection information in the timing display mode. In this case the X-fine information consists of an 8 bit counter to display 8 successive bits.

– Y-deflection
Port D1317 applies 8 parallel bits to DAC D1314, thus obtaining a prepositioning analog deflection current which is applied to the final Y-amplifier via cables 000 and 111.
DAC 1337, the output of which is in parallel with the output of DAC 1314, is used to supply additional data required for the Y-deflection. Inputs p. 8 and p. 9 of D1337 contain the Y-offset information to reach the heading area in the display via latches D1322 and D1323.
Inputs p. 10, 11, 12 of D1337 are used to supply row-position indication at character presentation, or the appropriate Y-deflection in timing displays (fig.1.15).

– Timing display
The quasi waveforms which are displayed in the timing-modes, are generated as follows:
The micro-processor puts successively 8-bit words from the data-RAM in port D1319.
The 3-bit X-fine count-function selects successively one bit (with X-fine on p. 9, 10, 11 of D1342), while synchronously the X-deflection is incremented with X-fine control on p. 10, 11, 12 of D1336.
After completion of 8 bits the input control of DAC D1313 is increased, so that the next group of 8 bits can be put on the screen a.s.o. Signal IVBB7 (unblanking signal) controls the Z-amplifier via D1338, D1339 and D1341.

– Character display
Characters are represented with the character generator D1321, which is a 64 character of 6 x 8 bits PROM, delivering a character pattern of 5 x 7 bits.
The character is selected with inputs p. 17 ... 22 of D1321, via port D1319. The specific column of the character is selected with inputs p. 14, 15, 16 of D1321, via port D1318. The character generator D1321 outputs one complete column of a character.
Dependent on the column number the DAC D1336 is controlled (inputs p. 9, 10, 11) to put the column in the correct position in the character-field.
The data-selector D1343, selects one bit from this column, under row-control

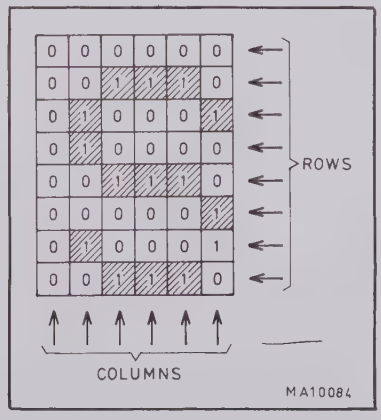


Fig. 1.15. Character presentation

(inputs p. 9, 10, 11) via port D1318. The same row control is applied to DAC D1337 (inputs p. 10), 11, 12 via gates D1338), for bit position in the Y-deflection.
The output signal of D1343 is applied to the Z-amplifier, via D1339, D1341, and cable 333.

- Map display
  The display of the dot-pattern is under control of DAC's D1313 and D1314 only, because in each X or Y direction only max. 256 different dots are required.
  During positioning of the spot the c.r.t. is blanked, only if the dot has been positioned on the screen one Z-pulse is generated (IVBB7).
- Z-intensified
  The Z-intensified information is applied to the Z-amplifier via latch D1323.
  This signal is used e.g. for intensifying faulty bits in the compare mode.

1.6. FINAL X AND Y AMPLIFIERS

Circuit diagram Fig. 15

Unit Fig. 17

Both amplifiers are symmetrical, and are driven by the digital-to-analog converters D1313, 1314 and D1336, 1337, which are located on the micro processor unit.
Both amplifiers have two potmeters in the input section, to adjust the deflection plate bias voltage and the symmetry of the circuits.

1.7. C.R.T. CIRCUITS

. **General**

Refer to:

Intensity, Focus and c.r.t. circuits Fig. 16

Unit Fig. 17

This circuit comprises amplifiers for both intensity and focus control.
Both amplifiers have separate circuits for a.c. and d.c. signals, and also isolate the negative electron-gun assemlby voltage from the remaining circuits.

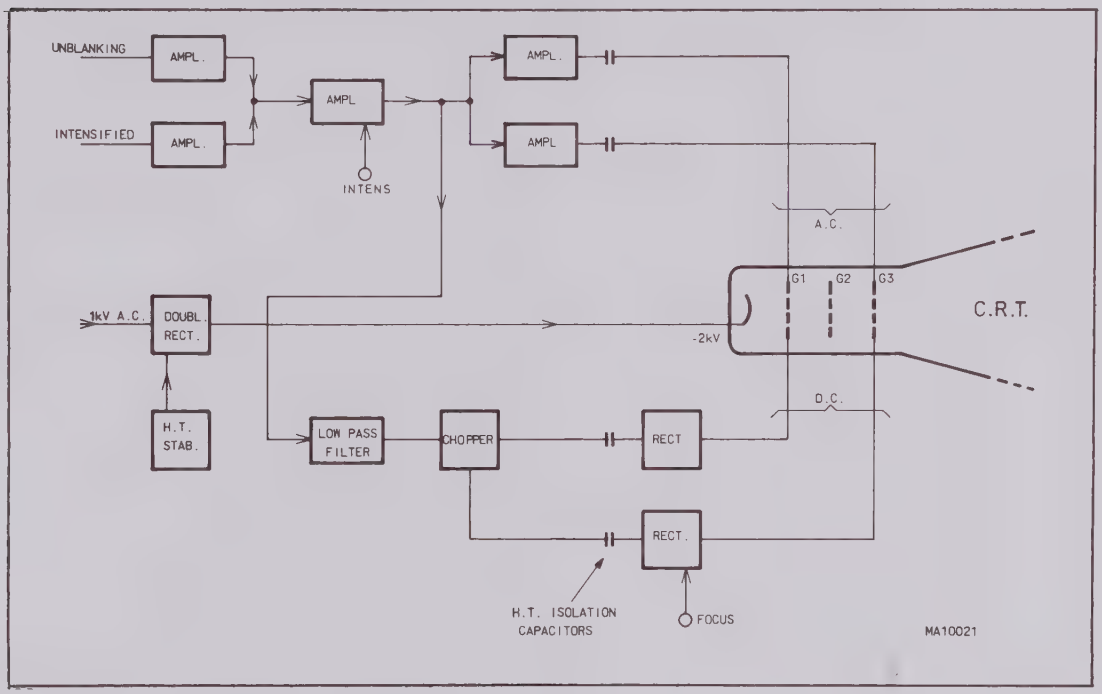


Fig. 1.16. Block diagram c.r.t. circuits

. **C.r.t. cathode**

The negative cathode voltage for the c.r.t. is obtained by the 1 kV a.c. voltage from the power supply unit and the voltage-doubler rectifier circuit C1118, C1119,V1117, V1118.
The appropriate grid-bias voltage for the c.r.t. is obtained with the gas-filled tube V1119.

. C.r.t. grid (G1)

The grid voltage which controls the brightness of the display depends on:

- INTENS pot meter R6 at the front panel.
- The unblanking signal on V1101.
- The intensified signal on V1103 (cursor in time display, and faulty digit in compare mode).

As the grid voltage is very close to the cathode voltage of the c.r.t. a high voltage isolation is required between the grid and the corresponding drive circuits.
This grid drive circuit has been split-up into two branches in parallel. One for the a.c. components of the signal via C1115, and one for the d.c. component via C1131.
The d.c. component of the intensity signal is first modulated on an a.c. signal and then applied via C1131 to a demodulator circuit.
At transistor V1106 the complete intensity signal is present.
Via the amplifier V1107 ... 1109, V1113, V1112 and C1115, the a.c. component of the intensity is applied to G1.

The d.c. component of the signal is obtained via the low-pass filter R1166, C1128 and applied to an oscillator circuit consisting of V1129, V1131 and V1134.
The output signal from V1134 is applied via C1131 to the demodulator circuit V1136, V1137.
The obtained d.c. voltage across C1130 is applied to G1, via R1177, R1178.

. **C.r.t. focus grid (G3)**

As with the intensity control cricuit, the focus circuit also requires high voltage isolation.
For the a.c. components this is C1112, and for the d.c. component C1129. There are a.c. omponents in the focus control voltage, because dynamic focus drive is applied. With dynamic focus drive, the intensity control voltage is also applied to the focus grid (G3) in order to obtain optimum focus at the various brightness levels.

The focus level is set with the FOCUS pot meter R3 at the front panel. Via V1144, V1143 and R1181, R1180 the d.c. voltage at C1135 is controlled.
The a.c. components of the intensity signal are applied to the focus grid via V1115, V1110 and V1112.
The (modulated) d.c. component of the intensity signal is applied via C1129 to the demodulator circuit V1138, V1139.
The obtained d.c. voltage accross C1135 is applied to the focus grid R1171 and R1179.

. **High voltage regulation**

The "0" of the 1 kV a.c. supply is grounded via diodes V1121, V1122, or via transistors V1123, V1124, dependent on the polarity of the a.c. voltage.
Transistor V1126 is controlled by the rectified high voltage across C1123, via R1143.
If, for example the high voltage tends to decrease, the base voltage of V1126 changes in the positive direction, which will increase the base current of V1124.
As a result, the resistance between "0" and gnd will get lower, thus increasing the high voltage again.

1.8. POWER SUPPLY UNIT

. General

Refer to:

Primary circuit	Fig. 19
Primary unit	Fig. 20
Secondary circuit	Fig. 21
Secondary unit	Fig. 22

This unit consists off:

- The primary circuit.
- The converter transformer.
- The secundary circuit.

These three parts are located in a screened box.

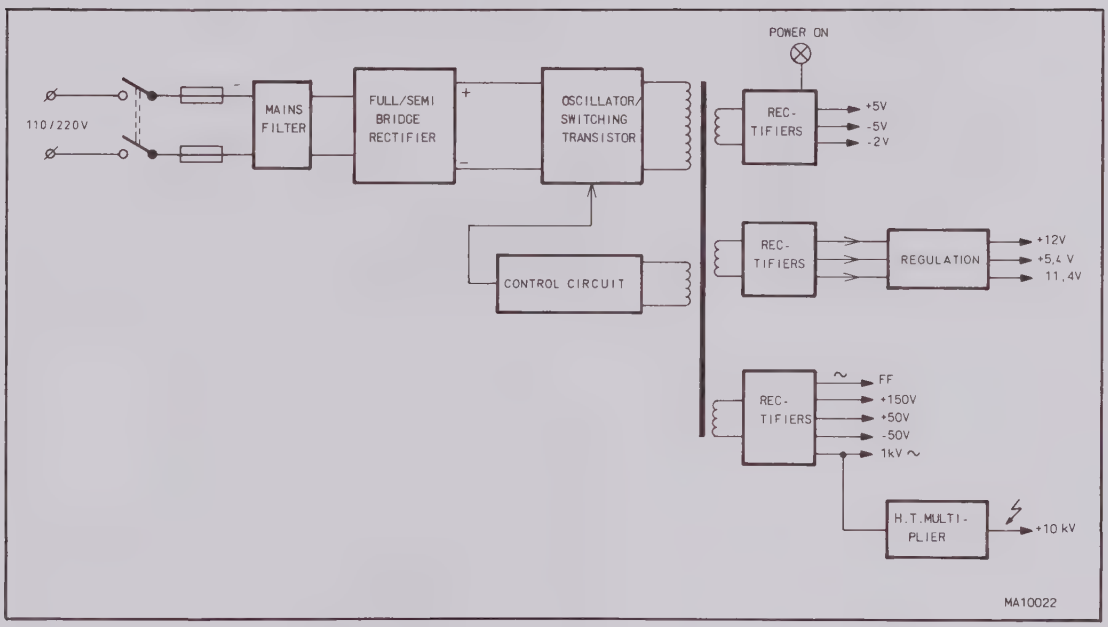


Fig. 1.17. Block diagram power supply

. The primary circuit

- Input circuit

  The power supply circuit can be adapted to the 115 V or 230 V range with selector switch S45 which is located at the rear panel. Though this switch has four positions, only two voltage ranges can be selected (the positions 110 and 127, and 220 and 240 V have been interconnected respectively).

  The mains voltage is rectified with two bridge rectifiers V1801, V1802 inparallel, which form a voltage doubler in the 115 V range, and a normal rectifier in the 230 V range.

- Switching circuit

  The unregulated d.c. voltage is applied in the form of pulses to a resonance circuit consisting of the primary coil of the converter transformer T1801, and C1807, C1808 via switching transistor V1806. The sine-wave voltage accross the primary of T1801 is kept constant by regulating the duty cycle of the base current of V1806.
  The primary coil of L1806 which is in series with the switching transistor, limits the current through this transistor.
  The energy stored in L1806 is fed-back to the mains rectifier circuit, during the cut-off time of V1806, via diode V1811.
  V1808 and V1809 keep the dissipation during the switching moments out of transistor V1806; instead of these losses are dissipated in R1814 and R2816.
  V1807 improves the base drive for V1806.

. **Regulator circuit**

The regulator circuit consists of integrated circuit D1801 (type TDA 1060), the output (p. 15) of which supplies a square wave current with variable duty-cycle to the base of V1812.
The collector signal of V1812 is applied to the switching transistor via transformer L1803.
The regulator circuit is controlled by:

– Current limit (p. 11)
The voltage drop across the current-sense resistor R1811 controls the regulator circuit in case of overload.
If the voltage on p. 11 is between 480 mV and 600 mV the output pulse is inhibited until the next period. If this voltage exceeds 600 mV the output signal is inhibited during a number of periods.

– Frequency
The switching frequency must be the same as the frequency of the resonance circuit T1801, C1807, C1808.
Pot meter R1829 controls the switching frequency (20 kHz).

– Feed-back voltage (p. 3)
This is the regulator control input voltage and is taken from the rectifier circuit at the feed-back winding of T1801.
This control voltage depends on the setting of R1828 (V out). The feed forward voltage is derived from the mains voltage via R1803 and R1822, and provides direct mains voltage variation compensation.

– Over-voltage protection (p. 13)
This voltage is derived from the mains voltage and inhibits the regulator output at too high mains voltages (the trip level on p. 13 is 600 mV).

– Switching-on
When switching-on the instrument, no supply voltages are available in the regulator circuit, from T1801. At this time V1804 is not conducting, so that V1803 is fully conducting, and the regulator circuit gets current via R1804 and R1806.
As soon as the converter circuit is working V1804 becomes conductive and V1803 is not conducting. Under normal working conditions the power supply voltages for the regulator circuit are delivered by the rectifier connected to the feed-back winding of T1801.
V1804 is then conducting so that V1803 does not deliver current.

– Switching-on protection
If the instrument is switched-on and no converter voltage appears (due to a possible defect) the PTC resistor T1806 will warm up, thus reducing the current through V1803 to a safe low value.

. **Secundary circuit**

This unit contains the various rectifier- and stabilizer circuits.

	+ 5 V	for several TTL circuits
	– 5 V, – 2 V	for ECL circuits (input unit and clock, trigger unit)
Stabilized	+12 V	for various circuits incl. threshold- and d.a.c. control
	+ 5,4 V	for analog input circuits and
	–11,4 V	for negative threshold control.

– Transformer T1815 supplies:

. the c.r.t. filament voltage (6,3 V a.c. at –2 kV level)
. 1 kV a.c. for the voltage-doubler rectifier circuit for the cathode circuit of the c.r.t.,
and for the 9 kV multiplying rectifier circuit (c.r.t. final anode).
. +150 V
. + 50 V and – 50 V for X and Y final amplifiers

2. Dismantling the instrument

2.1. GENERAL

This section provides the dismantling procedures required for the removal of components during repair operations. All circuit boards removed from the instrument should be adequately protected against damage, and all normal precautions regarding the use of tools must be observed. During dismantling procedures, a careful note must be made of all disconnected leads so that they may be reconnected to their correct terminals during assembly.

Warning: The opening of covers or removal of parts, except those to which access can be gained by hand, is likely to expose live parts, and also accessible terminals may be live.
The instrument shall be disconnected from all voltage sources before any adjustment, replacement or maintenance and repair during which the instrument will be opened.
If afterwards any adjustment, maintenance or repair of the opened instrument under voltage is inevitable, it shall be carried out only by a skilled person who is aware of the hazards involved.
Bear in mind that capacitors inside the instrument may still be charged even if the instrument has been separated from all voltage sources.
Be sure to discharge these components and circuits before working on them, to avoid the risk of hazardeous electric shocks.

2.2. REMOVING THE PARTS

. **Cabinet plates**

Both upper and lower cabinet plates can be removed, after slackening the four quick-release fasteners at the corners of each plate, one or two turns.
Do not slacken the fasteners more than two turns, otherwise they may fall apart.

. **Bezel**

Remove the c.r.t. bezel by pressing to its left hand side and slide loose.

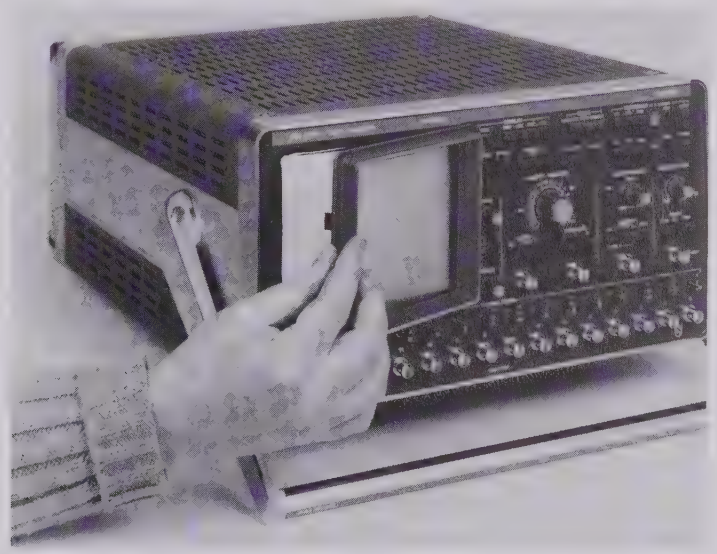


Fig. 2.1. Removing the c.r.t.'s bezel

. **Carrying handle**

First remove the plastic part of the centre-part of the handle.
Remove the centre-part by removing four screws.

For removing both side parts of the carrying handle remove both upper and bottom cabinet plates.
The left-hand bracket can be removed by rotating it as far as possible via the bottom to the rear (through the opening in the data memory p.c. board) and then pulling it sidewards.
The right-hand bracket can be removed by rotating it as far as possible via the top to the rear (as far as the power-supply shield) and then pulling it sidewards.
Apply some sealing varnish when fixing the four screws in the handle.

. **Control knobs**

Three rotary controls are provided with slide-on knobs: INTENS, FOCUS and DISPLAY TIME.
The TRIGGER DELAY control knob is provided with a clamp-device.
To remove this knob, remove the cap of the knob, and slacken the innernut.
The SAMPLE INTERVAL knob is also provided with a clamp-device; use a 10 mm wrench.

. **Text plate**

Remove the c.r.t. bezel.
Remove all front panel knobs.
Remove the upper nut of the SAMPLE INTERVAL switch.
Remove the next plate.

. **Cathode ray tube**

Remove the c.r.t.'s bezel.
Remove the plastic isolation lid at the rear of the instrument.
Disconnect the connector of the c.r.t. correction coil at the X.Y.Z. p.c.-board.
Disconnect the EHT connector from the c.r.t. cone (if necessary make room by loosening the μP unit).
Loosen the screw which secures the c.r.t. in the rubber clamping.
Take the c.r.t. out through the front panel.

When mounting the c.r.t. be sure to apply some talcum powder in the rubber clamping, to avoid the c.r.t. sticking to the rubber after long periods.

. **Magnetic screening**

To remove the magnetic screening (which shields the c.r.t. against stray magnetic fields) first remove the c.r.t.
Remove the two screws which secure the magnetic screening to the rear panel.
Remove the upper profiled rim from the rear panel by removing three screws.
Remove the magnetic screening.

. **Microprocessor p.c. board**

Remove the four screws which secure this unit at the front panel.
Remove the three screws which secure this unit at the rear.
Remove the various cable connections.
Remove the unit.

For Service-purposes the micro-processor unit can be fixed in the up-right position with one screw, against the power supply screening box. Be sure not to disconnect the green earth wire connection from the E.H.T. multiplying rectifier to ground. See fig. 2.2.

Also the micro-processor unit can be laid up-side down on the c.r.t. shield (don't forget to isolate).

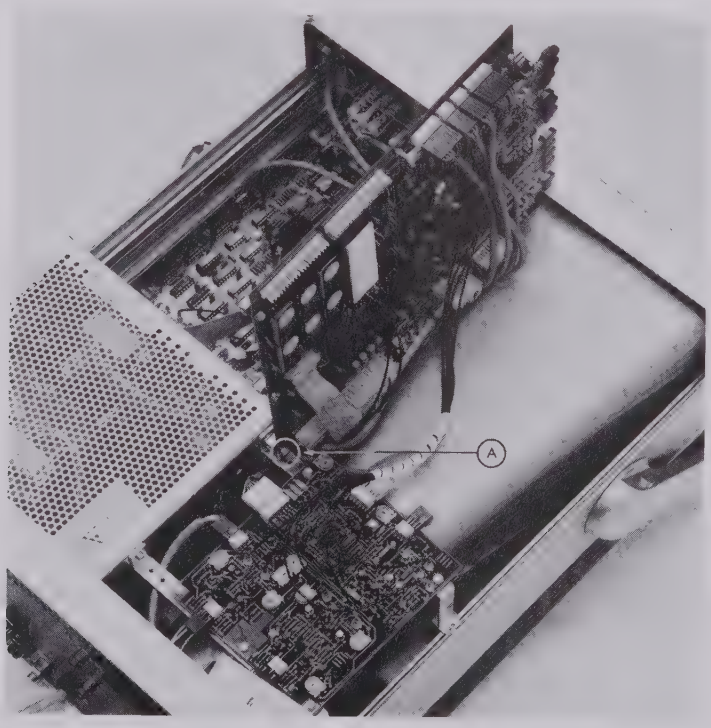


Fig. 2.2. Micro-processor unit mounted upright

. **Clock and trigger p.c. board**

This unit is located underneath the microprocessor unit which must first be removed.
Remove two screws which secure the switch assemblies of this unit to the front panel (save the two clamping pieces).
Remove the various cable connections.
Remove the unit.

When mounting this unit again the switch assembly clamping pieces can be glued together with a non-hardening glue to prevent them falling apart during mounting.

. **Power supply unit (p.s.u.) and focus unit**

Remove the perforated screening plate at the upper side of the power supply unit.

P.s.u. primary section
Remove the screw at the rear which secures the unit against the rear panel.
Remove the two Allen key screws on the p.c. board.
Disconnect the plug.
Remove the unit.

P.s.u. secondary section
Loosen the three screws at outside of the box.
Disconnect one red and three green wires.
Disconnect the two big plugs and the small plug.
Note that both big plug pin-sides are in parallel, so these plugs may be interchenged.
Move the unit slightly upwards and remove the two remaining grey wires.

Focus unit
Disconnect the three wires from the auxiliary Z unit.
Disconnect the two wires from the c.r.t. socket.
Remove the two screws.
Remove the unit.

. **E.H.T. unit**

Before working in the E.H.T. circuits be sure to discharge them.

Disconnect the grey wire of this unit from the secondary section of the power supply unit.
Disconnect the E.H.T. cable from the c.r.t.
Disconnect the green wire.
Remove the unit.

. **Auxiliary Z unit**

This unit can be removed by removing two screws.

. **Input unit**

Remove the five screws which secure the unit to the front panel.
Remove the five screws which secure the unit to the rear side.
Disconnect the cables.
Remove the unit.

. **Memory unit**

Remove fifteen screws.
Disconnect the cables.
Remove the unit.

. **Micro-processor (8X300)**

In case the micro-processor has to be removed, because of the possibility of damaging either the pins or the printed circuit board the following system is recommended: cut a piece of thin card-board and slide it under the micro-processor (fig. 2.3), use a screwdriver on alternate ends to obtain a straight lift. (The card-board prevents the tracks under the micro-processor from being damaged).

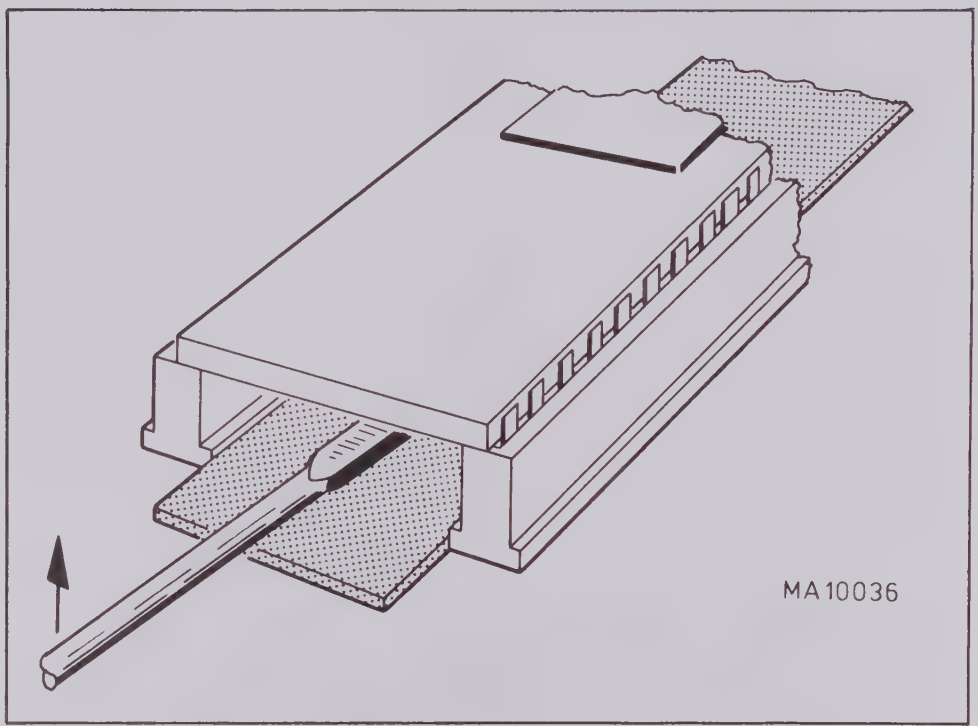


Fig. 2.3. Removing the micro-processor

2.3. PROGRAMMED I.C.'s LOCATION

See fig. 14

. **Program memory**

The ROM, which contains the working program and the system test program for the micro-processor, consists of six different integrated circuits (D1301 ... 1307), which have been labelled A ... F.

Note that each ROM I.C. must be in its proper location.
In case of a defective ROM all six I.C.'s must be replaced.

. **IV byte registers**

These four registers (D1316 ... 1319) have been pre-programmed to four different addresses and are labelled 001 ... 004.
Each IV byte register must be in its proper location.

2.4. SOLDERING MICRO-MINIATURE TRANSISTORS

On the input p.c. board some micro-miniature (SOT-23) transistors are used.
Because of the small dimensions of these transistors and the lack of space between the components on the printed-circuit board, it is necessary to use a miniature soldering iron with a pin-point tip (max. dia 1mm).

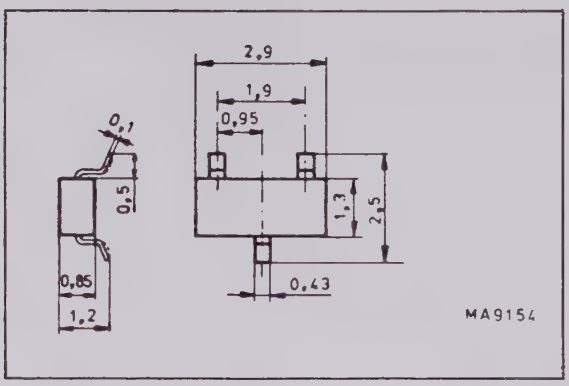


Fig. 2.4. Dimensional drawing micro-miniature semi conductors

Working method:
- Carefully unsolder one after the other the soldering tags of the semi-conductor.
- Remove all superfluous soldering material. Use a sucking iron or sucking copper litze wire.
- Check that the tags of the replacement part are clean and pre-tinned on the soldering places.
- Locate the replacement semi-conductor exactly on its place, and solder each tag to the relevant printed conductor on the circuit board.

Note: Bear in mind that the maximum permissible soldering time is 10 seconds during which the temperature of the tags must not exceed 250 deg C. The use of a solder with a low melting point is therefore recommended.

Take care not to damage the plastic encapsulation of these parts during the soldering procedure (softening point of the plastic is 150 ^{o}C).

ATTENTION: When you are soldering inside the instrument it is essential to use a low-voltage soldering iron, the tip of which must be earthed to the mass of the oscilloscope.

Suitable soldering irons are:

- ORYX micro-miniature soldering instrument, type 6A, voltage 6 V, in combination with PLATO pin-point tip type 0-569.
- ERSA miniature soldering iron, type minor 040 B, voltage 6 V.
- Low Voltage Mini Soldering Iron, Type 800/12 W - 6 V, power 12 W, voltage 6 V, order no. 4822 395 10004, in combination with 1 mm-pin-point tip, order no. 4822 395 10012.

2.5. REPLACING A PUSH-BUTTON SWITCH

Each of the push-button sets is fitted to the front panel by means of two clamping devices secured by Allen-key screws, see fig. 2.5.

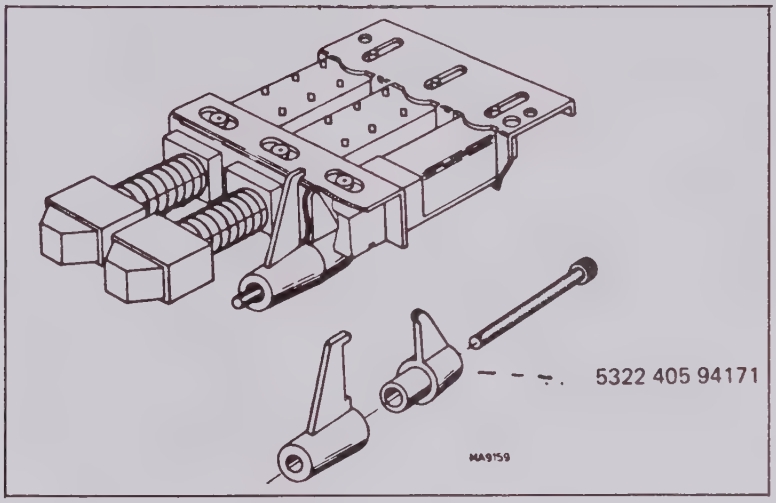


Fig. 2.5. Push button set clamping device

To remove a push-button switch, the Allen-key screws that secure it to the front panel must be removed. To replace one switch-section of a push-button set, refer to fig. 2.6.

To remove a push-button switch which is mounted on a p.c.board:

- Remove the printed-circuitboard for replacing a switch in this unit.
- Straighten the 4 retaining lugs of the relevant switch as shown in fig. 2.6.
- Break the body of the relevant switch by means of a pair of pliers and remove the pieces. The soldering pins are then accessible.
- Remove the soldering pins and clean the holes in the printed-wiring board (e.g. with a suction soldering iron).
- Solder the new switch onto the printed-circuit board.
- Band the 4 retaining lugs back to their original positions.

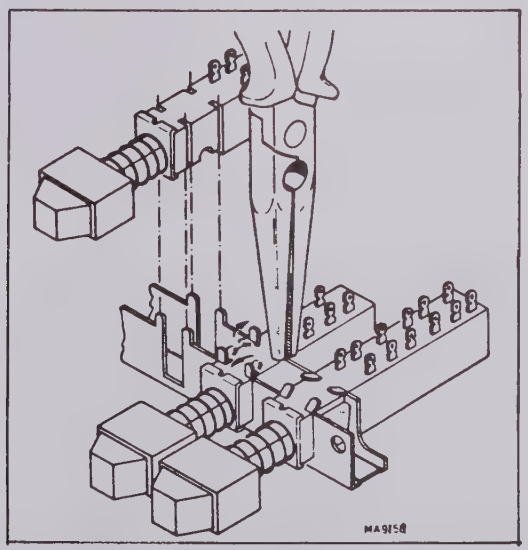


Fig. 2.6. Replacing a switch-segment

Note: Before a push-button switch is refitted to the front panel, it is advisable to stick the two parts of the clamping device together by means of adhesive tape or non-hardening glue, in order to facilitate replacement, refer to fig. 2.5.

3. Test and repair hints

3.1. GENERAL

This chapter is to assist fault-finding in the micro-processor circuits and other circuits which are under micro-processor control.

. **Recommended test instruments**

- Though most of the wave form diagrams in this chapter have been taken with a 2-channel oscilloscope, use of a 4-channel oscilloscope is strongly recommended e.g. PM 3244 or PM 3264.
- Logic pulser, used to check simple in-circuit functions of integrated circuits.
- Logic indicator probe.
- Current tracer probe, to detect and to trace short circuit current on p.c. boards.

. **Service switch**

This switch enables selection of either the normal program or the self test program, and is located on the micro-processor board.
This switch consists of two sections, one selects the normal or the selftest program, the other disables the watch-dog in the self test program

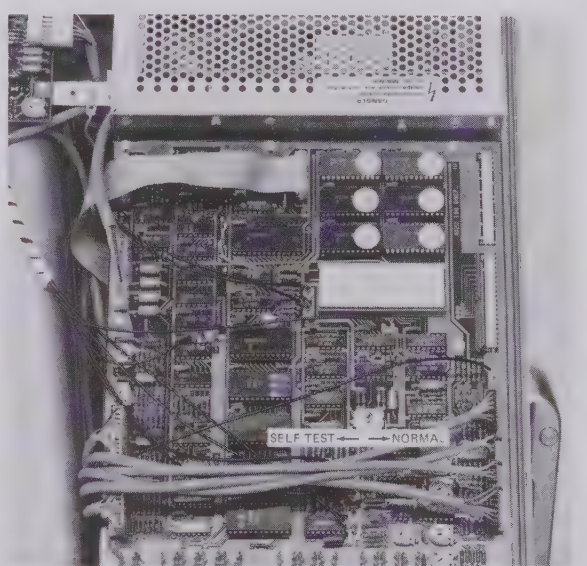


Fig. 3.1. Service switch on micro-processor board

. **Oscilloscope checking of micro-processor bus signals**

The 8X300 micro-processor (D1308) is provided with the following busses:

- Address bus (13 lines).
- Instruction bus (16 lines).
- IV bus (8 lines).

In general, if signals on these bus lines are checked with an oscilloscope, a very unstable display will be the result.
This is due to the fact that these signals vary with time in a rather unpredictable way.
If anyhow a stable display of address-instruction - or IV bus signals is obtained, this may be an indication that the micro-processor runs in a small program loop.
This phenomena is used when finding faults in the power-up test.

. **Simple micro-processor tests**

– Instruction bus "high" test.
Connect point 38 of connector X1305 to gnd. (See fig. 3.4.).
This disables all PROM circuits, so that the instruction bus is all "1".
This is a JMP to address 17777(8) instruction for the micro-processor.
A stable situation around the micro-processor is now obtained, see fig, 3.2.
In the normal mode, the watch dog control can be found on the address bus and the $\overline{\text{REST}}$ input.
The conditions on the IV bus are unpredictable, but stable.
Remove the ground connection at point 38 after this test.

Instruction bus "low" test

This test may only be carried out if the six Prom i.c.'s are of the 82S180 version (so skip if Prom's are of the 82S181 version).
Connect all 16 lines of the 8X300 Instruction bus to ground (for the 82S180 this is permitted because of their open collector outputs).
The instruction lines (I0 ... I15) can be grounded with pin connection wires on X1305; see fig. 3.4.
The 8X300 is now in the free-run mode and reads continuously a NOP instruction. The address bus is now continuously incrementing.
Check whether all address lines are dynamic.
Cycle times (approx.) : A1 : 1,3 ms
A12 : 0,65 μs.
The position of the Self test switch is not important.
Remove the ground connections again after this test.

IV bus test

If the micro-processor program does not work properly the activity on the IV bus can be checked (IVB0 ... 7).
Check that these lines do not stick to 0 V or +5 V.

I/O ports test

I/O ports D1316, 1317, 1318, 1319 interface the IV bus to the X, Y and Z circuits, which control the c.r.t. Though these ports are tested in the self-test program, it can be usefull to check the output activity of these ports (I.C. pins 1 ... 8).
In the normal program these lines may not stick to 0 or +5 V.
Only pins 1 and 2 of D1319 (003) are stable; they change if the Blank + or – switches are pressed.

. **Watch dog**

The watchdog circuit ensures that, if the micro-processor runs out of its normal program, this program is restarted from the begin address (0000).
Refer also to chapter: Circuit Description.
Somewhere in the normal program is a machine instruction that makes address line A0 high for a moment. This triggers a monostable multivib. D1311 (via D1312) which holds the rest input of the micro-processor high for approx. 1 sec.
Within this time that machine-instruction appears again thus retriggering the monostable multivibrator and thus holding the reset input of the micro-processor continuously high.
In case the micro-processor is not in the normal program, the reset input goes low, which forces the micro-processor to restart at the begin address.
The watchdog's high output on pin 43 of the micro-processor can be used to check whether the micro-processor runs in its normal program if for example no display is obtained.
The watchdog is disabled in the Selftest mode.

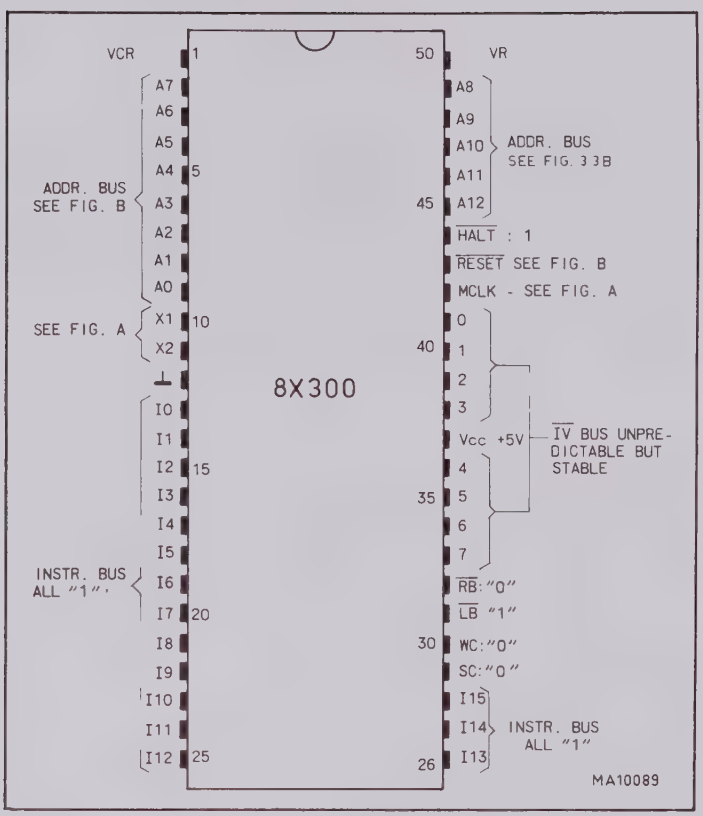


Fig. 3.2. Micro-processor at "bus high" test

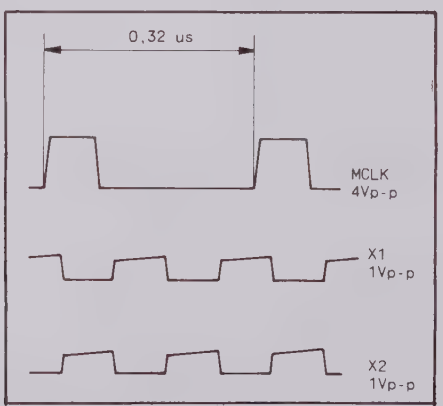


Fig. 3.3.a. Micro-processor clock wave forms

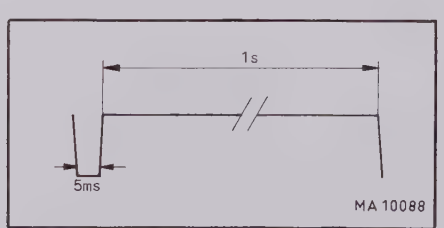


Fig. 3.3.b. Watch dog control in normal mode at "bus high" test

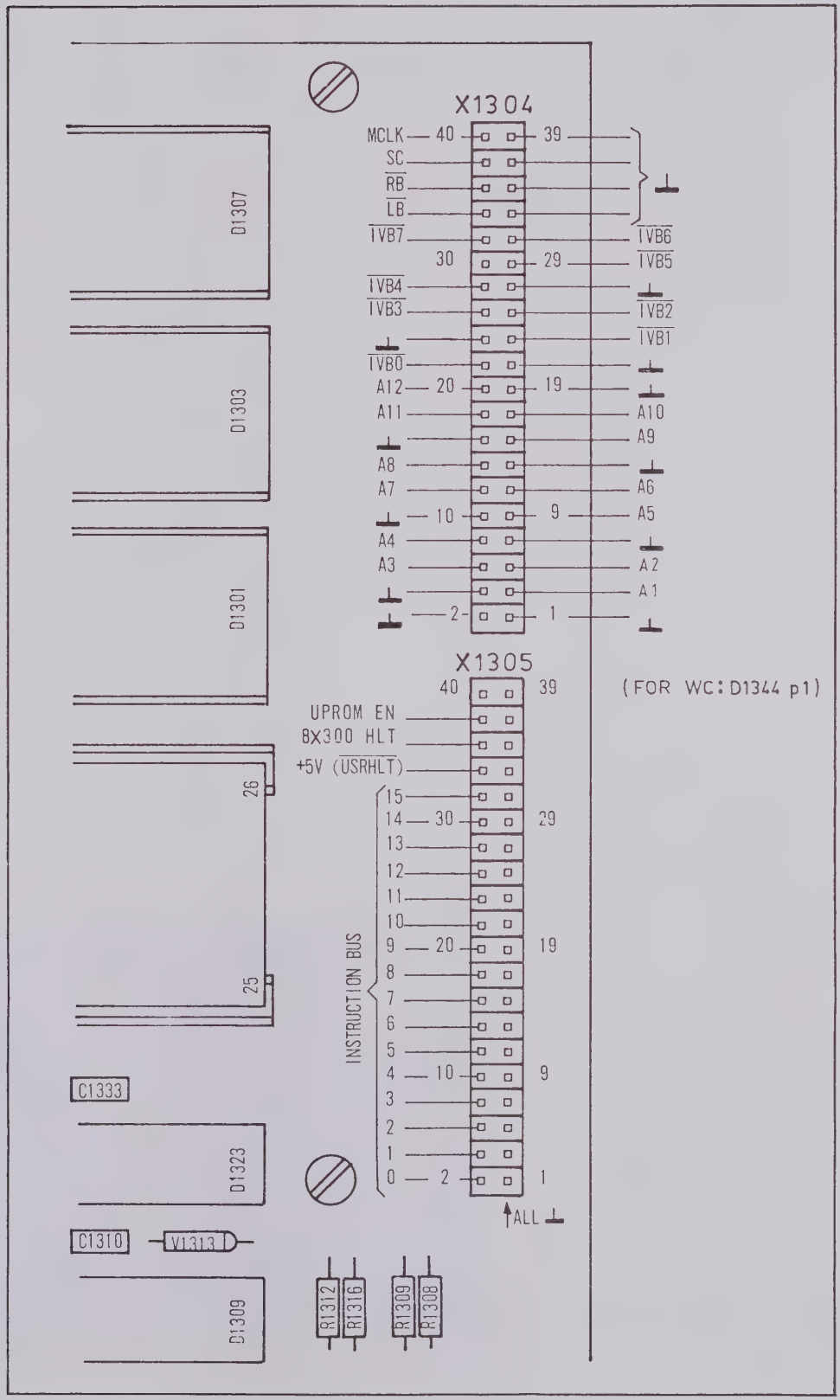


Fig. 3.4. Micro-processor system connections

3.2. SELF TESTS

. **Introduction**

The PM 3500 is provided with a self test program consisting of several tests. These test are non-selectable and selectable.

The non-selectable tests are carried-out automatically every time the power is switched on (power-up test).
The selectable tests can be executed if the Normal-Selftest switch located on the micro-processor board is in the Selftest position. The specific test can be selected by pressing the TRIGGER DELAY rotary knob.

. **Power-up test**

Every time the instrument is switched-on, the micro-processor excecutes the power-up test, which consists of:

- I/O Port test.
- Scratch-pad RAM test.

Normally the display on the c.r.t. appears approximately 30 s after switching-on.
If no display, or only one dot appears, one of the possibilities is that the micro-processor remains in the power-up test. The micro-processor is then continuously checking the address that delivers faulty data.
If it is thought that the micro-processor remains in the power-up test proceed as follows:
Check the SC and the $\overline{RB}$ (or $\overline{LB}$) outputs of the micro-processor.
If the $\overline{RB}$ (or $\overline{LB}$) signal is unstable during SC, the power-up test is finished succesfully.
If the $\overline{RB}$ signal is low (or $\overline{LB}$ high) during SC, the micro-processor hangs-up in the IV byte test.
If the $\overline{RB}$ signal is high (or $\overline{LB}$ low) during SC, the micro-processor hangs-up in the Scratch-pad RAM test.

I/O Port (IV byte) test

This test checks the right IV bank of the micro-processor, that is D1316 ... 1319. (Note that the $\overline{RB}$ signal must be continuously low during SC, during this test).
In each port 256 different 8-bit patterns are written and read-out again. If a difference occurs between the written and the read-out patterns, the micro-processor remains at this specific faulty pattern location.

Note that this test does not check the "users-side" of the ports. If it is found that the micro-processor hangs-up in the I/O port test, the defective port can be traced.
During SC, the address of the defective port is present on the IV bus.See fig.3.5.

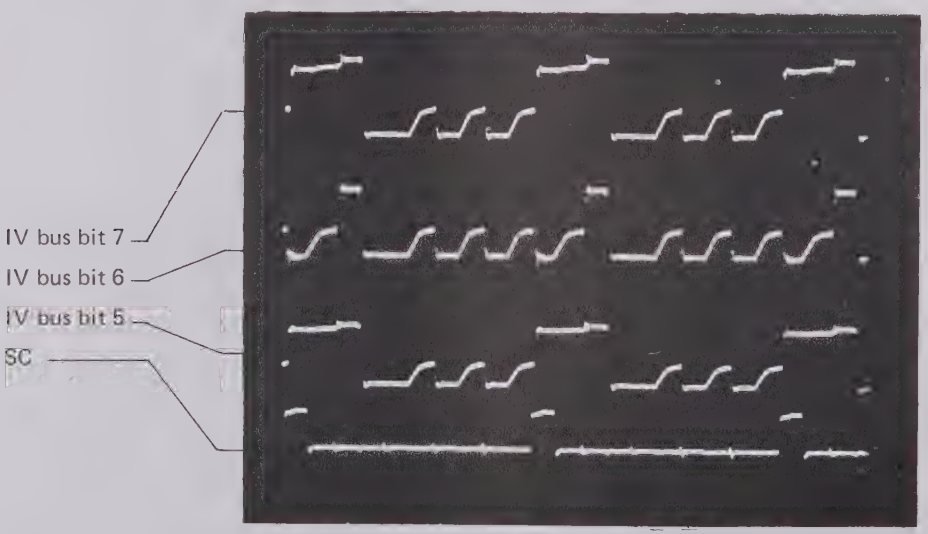


Fig. 3.5. Waveforms in IV byte test

The IV bus levels must be checked at the positive going edge of the MCLK during SC.
Though MCLK is not shown in this diagram we can see that IV bus bit 7 = high, bit 6 = low and bit 5 = high.

Referring to the next table we have now found that register 002 is defective.

Note that IV bus low is true.

IV bus bit no 0 1 2 3 4 5 6 7	Positive logic	Port address and stamp	Item no.
0 1 1	100	004	D1316
1 0 0	011	003	D1319
1 0 1	010	002	D1318
1 1 0	001	001	D1317

Scratchpad RAM test

This test checks the system RAM D1327 and the associated circuits as, address latches D1324, 1326 and data selectors D1328, 1329.
Refer to circuit diagram fig. 11.

If the $\overline{RB}$ signal is high ($\overline{LB}$ = low = active) during SC and the positive going edge of MCLK, the micro-processor has found a failure in this test.

It is useful to first check the address selection circuit of the RAM.

Proceed as follows:

1. Remove the micro processor from its socket.
2. Connect $\overline{LB}$ (X1304 p. 34) to gnd.
   This results in a continuous high ALE signal on the address latches D1324 and D1326.
3. Connect a pulser probe to an input of the latches.
   Check the function of these circuits by connecting the indicator probe alternately to the input and the output of a circuit.
   See fig. 3.6.

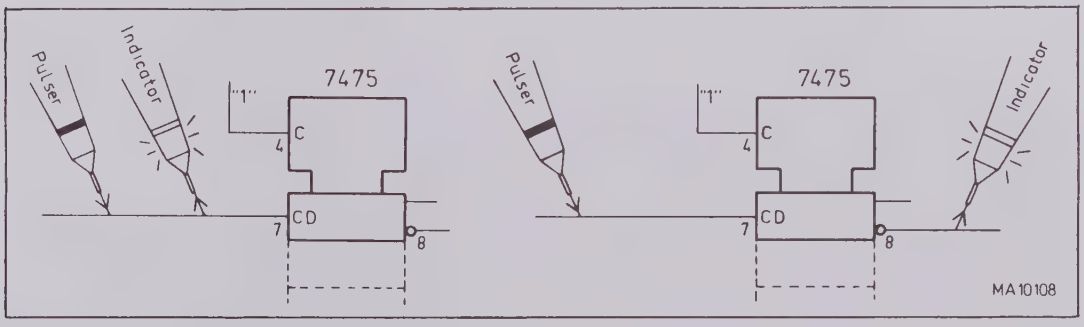


Fig. 3.6. Use of logic pulser and indicator probes

Always compare output with respect to input.

The best way is to inject the signals at the IV bus connections at the micro-processor socket, and to trace the signals up to the connections of the RAM (D1327).
Check that there is no short circuit between the lines.

Scratchpad RAM output

The output circuits D1328, 1329 of the scratchpad RAM can be checked as follows:

- Remove the micro-processor from its socket.
- Connect $\overline{IVB0} \rightarrow$ gnd, and
  $\overline{IVB1} \rightarrow$ +5 V
- Connect the $\overline{LB}$ to gnd. for a short moment (this makes D1326 : ALE "1" for a short moment).
  This results in:
  IVBL0 = "1"
  IVBL1 = "0"
- Remove the connections to $\overline{IVB0}$ and $\overline{IVB1}$ again.
  By above procedure the D1326 latches remain stable, with the written IVBL0, 1 outputs.
  The data selectors D1328 and D1329 have now been set to the output of the scratch pad RAM D1327.
- Connect SC → gnd
- Connect WC*) → gnd } Keep this sequence
- Connect $\overline{LB}$ → gnd

  *) WC = D1344 p. 1

  This results in a RD1 = "0" signal at D1328 and D1329.
- Check the circuit as follows:
  Apply the pulser probe to p. 17 of the scratchpad RAM D1327.
  Follow the signal via the data selector D1329 (and D1328) up to the $\overline{IVB0}$ pin at the micro-processor socket, and up to the $\overline{IVB0}$ input p. 11 of D1327.
  Repeat for the remaining output pins of D1327.
  After completion of this section remove the gnd. connections at SC, WC and $\overline{LB}$ again.

  If no fault can be found in the above scratchpad test, and yet the micro-processor remains in this test, the $\overline{WR1}$ pulse on p. 13 of D1327 can be checked.
  To this end, connect a logic indicator probe to p. 13 and put the service switch in the Normal mode.
  This enables the watch-dog circuit so that now a pulse on $\overline{WR1}$ must appear.

Data memory

The same procedure can be applied to check the output circuits of the Data memory (via connector X1303).

Proceed as follows:

- Remove the micro processor from its socket.
- Connect $\overline{IVB0}$ and $\overline{IVB1}$ both to gnd.
- Connect the $\overline{LB}$ to gnd, for a short moment (this makes D1326:ALE "1" for a short moment).
  This results in;
  IVBL0 = "1"
  IVBL1 = "0"
  Remove both gnd connections to $\overline{IVB0}$ and $\overline{IVB1}$ again.
  By above procedure the D1326 latches have now been set to the output of the Data memory.
- Connect SC to gnd;
- Connect WC to gnd; } Keep this sequence!
- Connect $\overline{LB}$ to gnd.
  This results in a $\overline{RD1}$ = "0" signal at D1328 and D1329.
- Check the circuit as follows:
  Apply the pulser probe to an output pin of the Data memory (e.g. D1501).

  Note that all outputs of the Data memory are in parallel.
  Follow the signal via connector X1303 up to the corresponding $\overline{IVB}$ pin on the micro-processor socket.
  Repeat for the remaining output pins of the Data memory.

. **Selectable tests (Service program)**

This program can be chosen by putting the switch on the micro-processor board to the selftest position, and consists of six selectable tests:

Test 1 : C.r.t. control.
Test 2 : Character generator.
Test 3 : Front panel switches.
Test 4 : Automatic input.
Test 5 : Input simulator.
Test 6 : Data Ram address counter.

Tests are selected by pressing the TRIGGER DELAY rotary knob. The first time when the switch on the micro-processor board has been put in the service program position, Test 1 and Test 2 are excecuted. After that a rolling display of test numbers is shown from which a certain test can be selected by pushing the rotary knob.

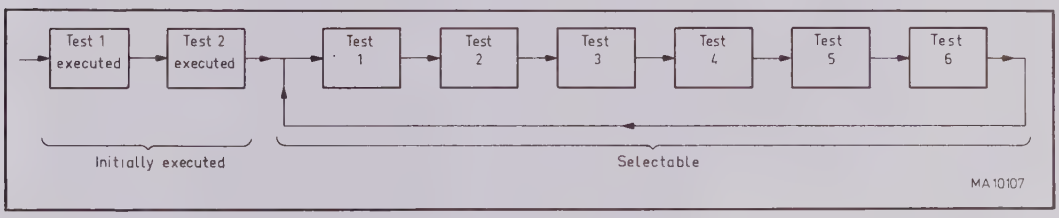


Fig. 3.7. Selectable test sequence

A test can be stopped by pushing the rotary knob again. Excepting test 5; to get out of test 5 the switch on the micro-processor board must be put in the Normal position for a moment.

Test 1 (display test)

If the circuits for horizontal and vertical deflection, and the brightness circuits of the cathode ray tube are working properly the display must be as in fig. 3.8.

This picture consists of:
- One dot in the bottom right corner.
- One dot in the top left corner.
- Two small slanting straight lines in the bottom left corner.

Fig. 3.8. Test 1 display

This display is generated as follows:

First the maximum deflection value is applied via D1316, the digital analog convertor D1313, and the amplifier for horizontal deflection to the c.r.t. (no vertical deflection).
Two unblanking pulses are then applied, the horizontal deflection is then zero again.
Next the same is executed via D1317, and dac D1314 for vertical deflection (no horizontal deflection).
Lastly the two small lines are generated via dac D1336 (X deflection and dac D1337 (Y deflection) combined with 16 unblanking pulses.

Dac's D1313 and D1314 are used for the full range c.r.t. deflection, the two unblanking pulses during each dot can be used to check the dac's, and the bandwidth of the deflection amplifiers.
Dac's D1336 and D1337 are used for character writing.

If the display does not conform to fig. 3.8. the signals can be checked with an oscilloscope as follows:

- Trigger the test oscilloscope externally with the signal at point TR at the micro-processor board.
- Take the Y voltage from p. 4 of X1106 on the X-Y-Z board.
- Take the X voltage from p. 1 of X1107 on the X-Y-Z board.
- Time base test oscilloscope 5 μS/div.
- The signals are indicated in fig. 3.9.

TB 5 μs/DIV
Ext. trig. from TR
Y Pulse ampl. 20 Vp.p.
X Pulse ampl. 90 Vp.p.

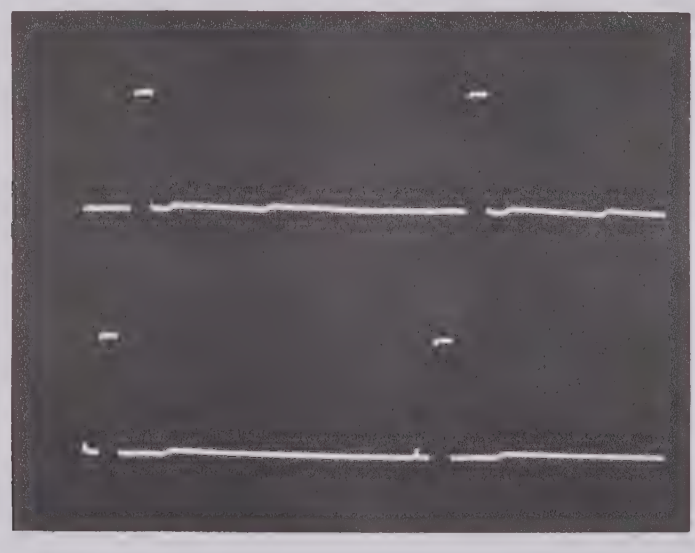


Fig. 3.9. Test 1 X and Y deflection voltages

- The two small lines in the left-bottom corner (fig. 3.8.) are made by X and Y rampvoltages which can be seen if the gain of the test oscilloscope is increased. See fig. 3.10.

TB 5 μs/DIV
Ext. trig. from TR
Y Ramp-voltage: 600 mVp.p.
X Ramp-voltage: 1,2 Vp.p.

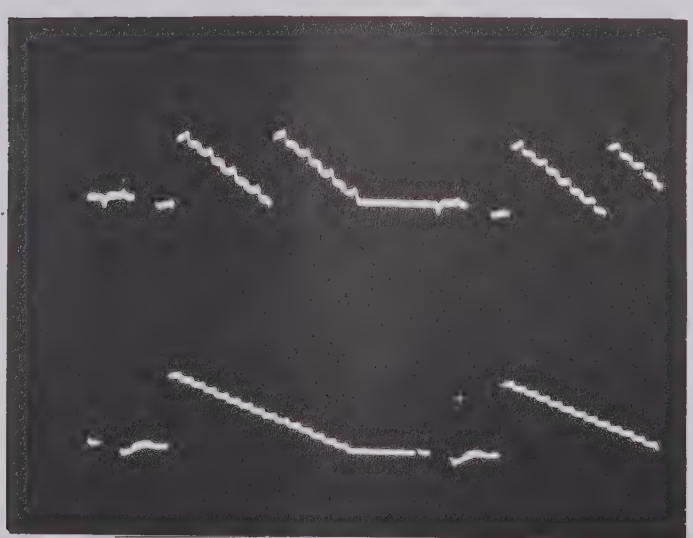


Fig. 3.10. Test 1 X and Y ramp deflection voltages

– Compare the Z-voltage with the Y-voltage. The Z-voltage is taken from R1342 on the microprocessor board. See fig. 3.11.

TB 5 µs/DIV
Ext. trig. from TR
Z signal (at R1342): 4,5 Vp.p.

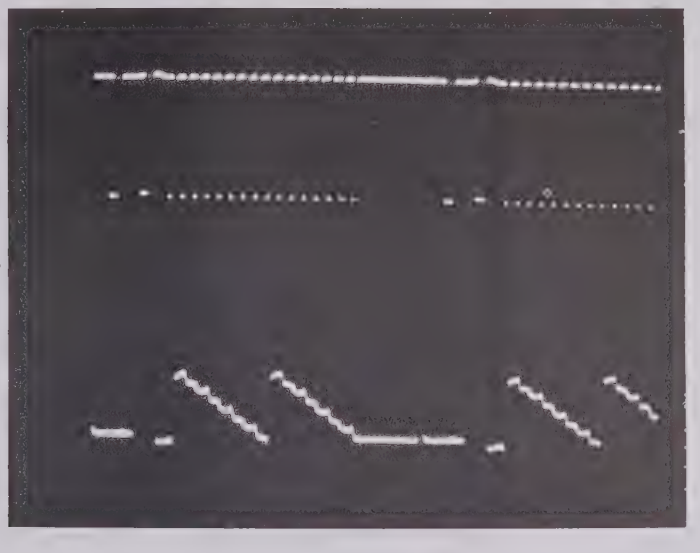


Fig. 3.11. Test 1 Z signal compared with Y voltage

– Compare the Z-voltage with the X-voltage. See fig. 3.12.

TB 5 µs/DIV
Ext. trig. from TR
Z signal (at R1342): 4,5 Vp.p.

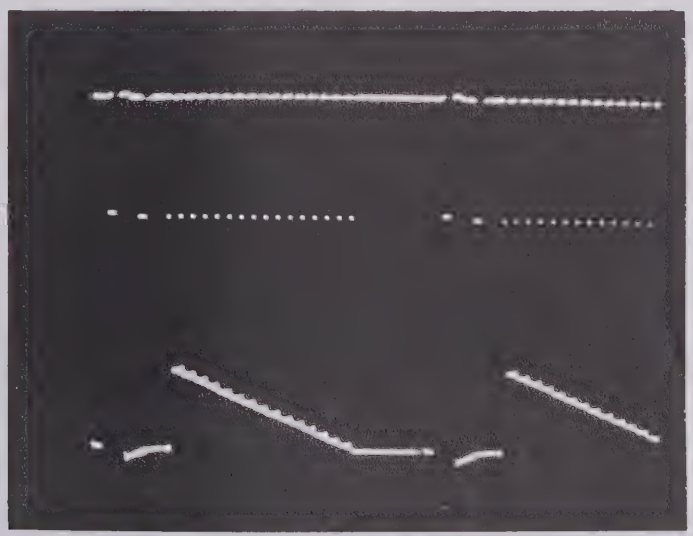


Fig. 3.12. Test 1 Z signal compared with X voltage

Also in this test the latches D1322 and D1323 can be checked. During the time that the pulse is present at TR (D1322 output p. 11), the signal at the following points is inverted:

D1322 p. 1, 8 and 11.
D1323 p. 8, 14 and 16.

Test 2 (Character generation)

This test puts all characters of the character generator D1321 on the display, see fig. 3.13. Port D1319 and multiplexer D1343 are included in this test.

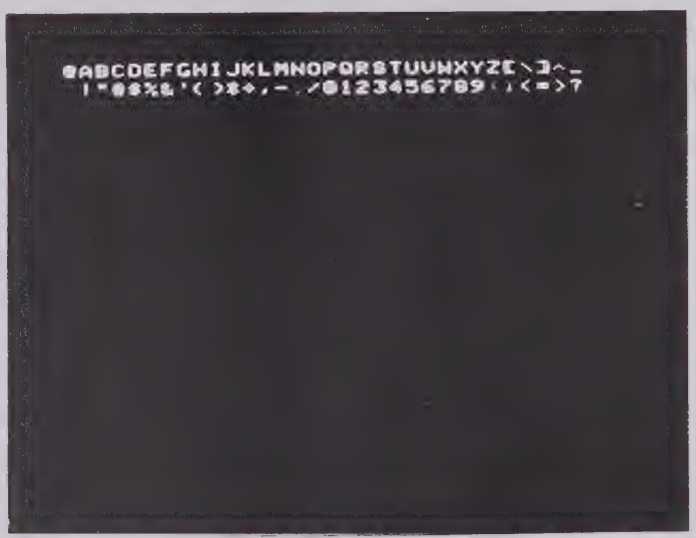


Fig. 3.13. Test 2 Character generation test

Test 3 (Front panel switches)

This test checks the working of the front panel switches as indicated in following table.

TIME	= 1	BLANK –	= 7	TRIGGER DELAY ON	= A
MAP	= 2	BLANK +	= 8	COMPARE	= B
HEX	= 3	CURSOR –	= 9	START MAN	= C
OCT	= 4	CURSOR +	= 10	START AUTO	= D
BIN	= 5	STORE REF	= 11	CURSOR FAST	= E
EXPAND	= 6	SEARCH	= 12		

If a button is pressed the corresponding number or letter appears on the screen, see fig. 3.14.

Fig. 3.14. Test 3 Knob SEARCH depressed

Note that switches 1 ... 12 are read by the micro-processor under matrix control. Switches A ... E are read by data selectors.

Test 4 (Input test)

In this test the input circuits with corresponding trigger and memory-circuits are checked.
Each input is successively tested with trigger 1 and 0. Test section and eventual error code are indicated on the display.
This test uses input signals which are generated by the micro-processor.

Initial setting:

MODE : SAMPLE
THRESHOLD : TTL
CLOCK : EXT ⌐
CLOCK QUAL : X
TRIGGER : INT
TRIGGERWORD : All X (except channel under test, see test)

Control switches:

START MAN : Starts a test section
CURSOR FAST : Can be used to select a certain channel and Trigger polariy.

Connections:

The signals are taken from points CL and DL on the micro-processor board using the standard PM 8800 probes.

– Apply the CL signal to the EXT. CLOCK input at the front panel.
– Apply the DL signal to the ch. 0 input at the front panel.

(Connect the gnd leads of both probes to earth on the micro-processor board).

Test procedure:
When test 4 has been selected the display is as indicated in fig. 3.15.

Fig. 3.15. Test 4 Initial display

Put the trigger switch of ch. 0 in position 1.
Push the START MAN button to start this test section. If this part of the circuit works properly, the next test display (CHANNEL 0 TRIG = 0) appears on the screen.

Now put the trigger switch of ch. 0 in position 0, and push the START MAN. button again.
If the result is correct the display now shows: CHANNEL 1 TRIG = 0.
Replace the DL probe input from ch. 0 to ch. 1.
Put the trigger switch of ch. 0 to X.
Put the trigger switch of ch. 1 to 1.

This way all channels can be checked with trigger 1 and 0.

With the CURSOR FAST button a individual test can be selected, without the necessity to execute all foregoing channel tests.

Error detection

If a result of one of these test sections is not correct, an error message is given in the display.

Three errorcodes are possible:

Error 1 : No stop signal.
The trigger circuit does not deliver the STOP signal.

Error 2 : Data bit written on a certain address in the data memory cannot be read-out again.

Error 3 : Data bit written in the memory can be read-out but more bits have been set.

Note, that if a trigger switch is not correctly set Error 2 is displayed after execution of the test section.

Description

This test consists of a walking 1 test (for TRIG = 1) and a walking 0 test (for TRIG = 0) for the 512 bit deep data memory, for each channel.
The same bit is used as trigger bit.

At the first part of a channel test (TRIG = 1) the memory is first cleared.
Then a "1" bit is written on the first address of the memory.
The same bit generates a "Stop" signal in the trigger circuit.
The micro-processor checks whether only the "1" bit on the first address is present.
This is repeated for all remaining addresses of the memory.

At the second part of a channel test (TRIG = 0) the memory is first set to all "1" 's.
Then a "0" bit is written on the first address of the memory, and the same "0" bit is used to generate a "Stop" signal in the trigger circuit.
The micro-processor checks the "0" bit on the first address and so on.
This procedure is repeated for each channel.

Test 5 (Continous input test)

In this test the channel inputs (0 ... 15) can be checked with the aid of a continuous signal.
There is no indication or test result on the display (display remains dark).
Signal tracing from the input to the memory, the trigger circuit and the trigger delay counter is now possible.

The micro-processor delivers the following signals:

- A data signal, which can be applied to any input 0 ... 15.
- A clock signal, applied to the EXT. CLOCK input.
- A start pulse used as trigger reference for a test oscilloscope.

At the beginning of each cycle (just before the start pulse) the micro-processor loads the trigger delay counter with 10.
(To get out of this test, the switch on the micro-processor board must be put in the "Normal" position for a moment).

Initial setting

MODE : SAMPLE
THRESHOLD : TTL
CLOCK : EXT ⎍
CLOCK QUAL : X
TRIGGER : INT
TRIGGER WORD : See test

Connections:

The signals are taken from points CL and DL on the microprocessor board using the standard PM 8800 probes:

- Apply the CL signal to the EXT. CLOCK input at the front panel.
- Apply the DL signal to the desired data input at the front panel.
  (Connect the gnd leads of both probes to earth on the micro-processor board).
- Apply the start signal, at the START output at the rear of the instrument, to the ext. trig. input of the test oscilloscope.

Test signals:

The micro-processor delivers (on point CL) asynchronous clock pulses.
The first 8 clock pulses the data line (point DL) is "1", and the next 8 clock pulses the data line is "0" and so on. Each group of 64 clock pulses is preceded with a start pulse (START out).

TB 5 µs/DIV
Trig. Ext. op "Start" signal

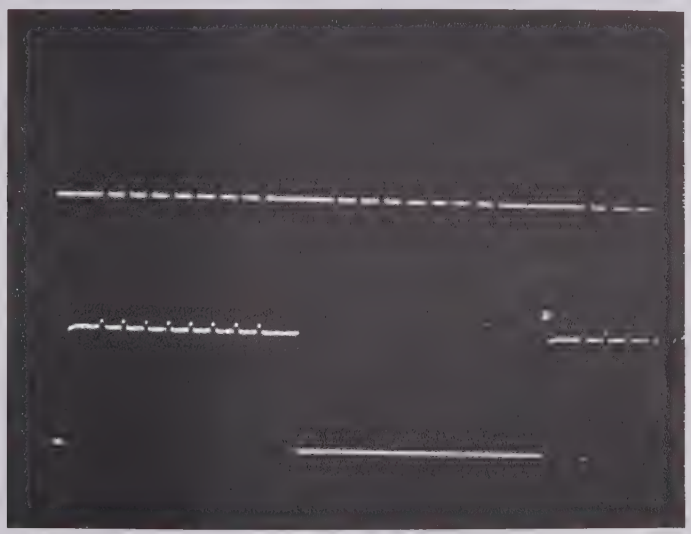


Fig. 3.16.a. Test 5

Input signal tracing

When checking signals in the input circuit, (including serial to parallel conversion, and memory input) the clock signals must remain running.
To enable this, set one of the trigger switches of the not-used inputs to the "1" position.
The triggerword is now not found, so the trigger circuit will not deliver a "stop" signal.
With the aid of the description of the serial to parallel conversion (refer to the relevant description). the various signals can be checked.

Every time two signals can be compared, using the Start-out signal as a external trigger source for the test oscilloscope.
Use of a 4-channel oscilloscope is of course recommended.
Even another logic analyzer would be very useful here.

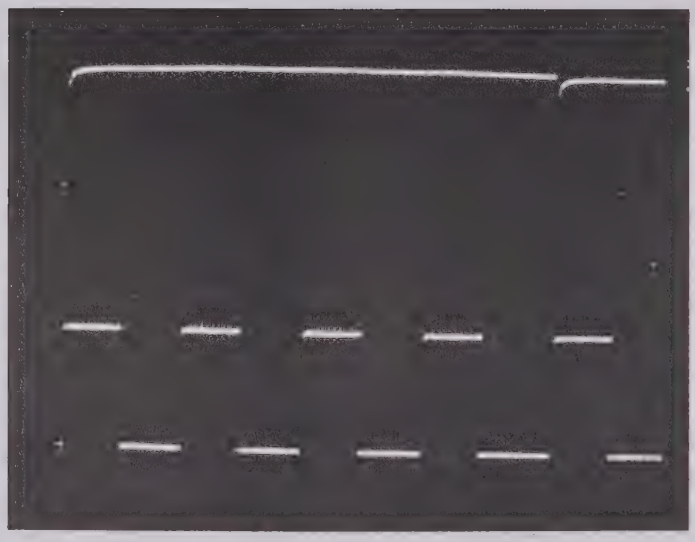


Fig. 3.16.b. Test 5

Clock

The CL signal can be traced in the external clock input circuit. The EXT ⎍ clock selection works also, and can also be checked.

The clock qualifier can now be checked. To enable this apply the DL signal which is on a channel input, also to the CL.QUAL. input. Qualifier "0" and "1" can be checked.

Note that qualifier "0" results in all "0" bits, and qualifier "1" results in all "1" bits in the data memory.

Trigger

In the same way the signals in the trigger circuit can be followed.
Put all trigger switches in the X positions, except the one of the channel under test.
Fig. 3.17. gives an example of checking signals in the trigger circuit.
Here the input and output signals of the count-enable latch D918 (p. 7 and 2 resp.) are compared.
(The $\overline{\text{CNTEN}}$ gets low the first moment that the signal at D918 p. 7 gets low, and remains low. D918 p. 7 follows the data input signal as long as the clock remains running. At the next Start pulse the $\overline{\text{CNTEN}}$ goes high again).

Fig. 3.17. Test 5 Example of Signal tracing

Test 6. Data Memory address counter test

In this test the micro-processor loads the address counters D928 and D936 with all numbers from 63 to 0 respectively, via D929 and D934.
Via D938 and D939 these numbers are read-out again.
The micro-processor compares the loaded values with the read-out values.

This test is repeated, until the DELAY rotary knob is pressed again.

If any difference is found between the loaded address number and the read-out number the micro-processor remains checking the faulty output. The TEST 6 indication then disappears.

Example

Fig. 3.18. shows the signals of the least significant bit at the input and output of D928.

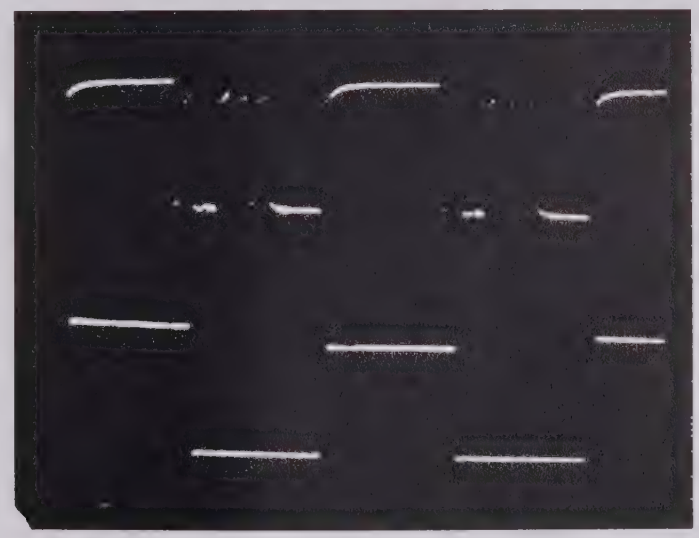


Fig. 3.18. Test 6

3.3. JUMPER-CONNECTIONS ON THE CLOCK-TRIGGER UNIT

The clock-trigger unit is provided with some jumper connections, which are used for fault-finding during production. Also for repair these jumpers may be used as indicated below.

X 907 – 908 Interconnection of these points forces a "1", to the input of the trigger-hold circuit. This prevents triggering, so the STOP signal will never be generated and the instrument continues sampling.

X 913 Removing X 913 interrupts the no-clock detection input.
To check this circuit, a signal between 0V and -5V maximum, can be applied to the corresponding coaxial connector (located near potentiometer R952).
This circuit (D 909) can also be used as convertor for an external signal to drive the internal clock circuits; refer to the following section.

X 915 Removing X 915, stops the 100 MHz master oscillator of the internal clock circuit.
For fault-finding purposes an external clock signal (ECL) with adjustable frequency can be applied to the corresponding coaxial connector (located near X 915).
Note that with no internal clock signal the c.r.t. display routine is not executed. (Set INTENS knob to minimum).
If no ECL signal is available the no-clock detection input circuit can be used as a signal level convertor.
To this end remove also X 913 and disconnect the cable which is connected to connector 99 on the micro-processor unit, and connect this cable to the connector near X 915 on the clock-trigger unit itself. An external signal between 0V and -5V maximum can now be applied to the connector located near R 952.

X 911, 912
X 914

These jumpers can be used to check the START function of the trigger circuits. Normally the fastest repetition rate of the START function is approx. 2 Hz (i.e. in the AUTO mode).
Use of an oscilloscope to check the START function is then rather difficult.
By opening X 911 and shortening X 912, the start circuit is no longer under microprocessor control (IVB6). The start function is now executed by a much higher frequency from the internal clock divider circuits, via X 914. An oscilloscope can now be used to check the various start and reset actions in the trigger circuit.
The frequency is selectable with X 914 at 20 KHz, 200 KHz or 2 MHz.

4. Checking and adjusting

4.1. GENERAL

The following information provides the complete checking and adjusting procedure for this instrument. Before any check or adjustment, the instrument must attain its normal operating temperature. Under average conditions this will be approximately 10 minutes after switching on.

All controls which are mentioned without item numbers are located on the front plate of the instrument.

For information on power-on test and self-test feature refer to chapter 3.

. **Preliminary settings**

- Check the mains voltage selector for correct setting.
- Switch on the instrument.
- Set INTENS and FOCUS for normal brightness and focus.
- No input signals required unless otherwise mentioned.
- Select all "don't care's" for trigger word recognition.
- Select BINary display mode.
- Select SAMPLE mode.
- Display all channels.
- Select INT clock.
- Clock interval: 1 μS.
- Clock qualifier "X".
- Trigger delay off.
- Trigger source internal.
- Start: Auto.
- Internal Service switch in position: Normal.

4.2. POWER SUPPLY

. **Power consumption**

– Check that the power consumption is approximately 110 W - 160 VA (measured with a moving-iron instrument), at nominal line voltage.
After any repair in the power supply circuit re-adjustment of the following potentiometers may be necessary.

. **Primary circuit:**

– V out R1828.
This potentiometer controls the output voltages of the power supply.
Adjust R1828 until the +5 V output voltage (blue wires at the plugs) is within + or –25 mV.

– Overload R1826.
This potentiometer controls the value of the maximum overload current in the power supply circuit.
If the load of the power supply exceeds 110 % of its nominal value, the overload protection must function (the POWER lamp blinks).
The overload must function if an additional load is connected to the power supply.
This additional load may consist of:
– A 6,2 ohm resistor between +5 V and 0 and
– A 6,2 ohm resistor between –5 V and 0.

– Frequency R1829.
This potentiometer controls the converter frequency of the power supply circuit.
If necessary adjust this potentiometer to 20 kHz.

. **Secondary circuit:**

– + 12 V R1867.
Adjust this potentiometer until the +12 V output voltage (black wires at the plugs) is within + of –60 mV.

– –11,4 V R1883.
Adjust this potentiometer until the –11,4 V output voltage (brown wires at the plugs) is within + or –55 mV.

4.3. INPUT CIRCUITS

Each input circuit is provided with a potentiometer to adjust the square wave response.

There are:

16 data inputs	:	R122, R172 ... R822, R872.
Ext. cloc	:	R922.
Clock qualifier	:	R952.
Ext. trig./qualifier	:	R982.

Each circuit can be adjusted as follows:

- Depress TTL threshold buttons.
- Connect a l.t.a. probe (PM 8800) to the relevant input connector.
- Apply a 100 Hz square wave TTL signal to the probe tip.
- Check the square-wave response of the input amplifier by checking the signal on the input of the corresponding comparator circuit (p. 6 or p. 12 of the MC 1651). The square-wave must have a flat top. If necessary adjust the corresponding potentiometer.

TTL/ECL threshold potentiometers.

(See fig. 14).

- TTL ch. 0 ... 7 R1434.
  The voltage on p. 4 of X1310 must be +0,83 V (+ or −15 mV).
  Ch. 8 ... 15 R1454.
  The voltage on p. 4 of X1311 must be +0,83 V (+ or −15 mV)
- ECL ch. 0 ... 7 R1436.
  The voltage on p. 4 of X1310 must be −0.67 V (+ or −10 mV).
  Ch. 8 ... 15 R1456.
  The voltage on p. 4 of X1311 must be −0.67 V (+ or − 10 mV).

If necessary check the correct detection of the logic levels with the aid of signals as indicated in fig. 4.1.

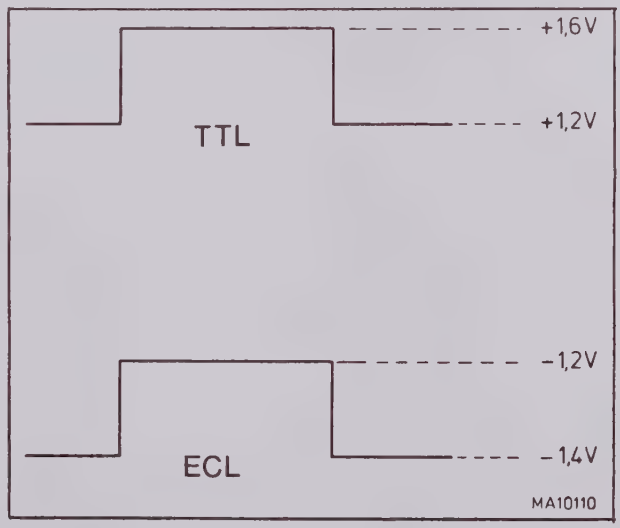


Fig. 4.1. TTL and ECL input test signals

Some readjustment of the 100 Hz square wave compensation potentiometers or threshold level potentiometers may be necessary to obtain optimum resulsts.

4.4. TRIGGER DELAY CIRCUIT

. **Delay setting frequency R1408.**

This potentiometer controls the frequency of the trigger delay setting generator.

. **Check the level on D1357 p. 3**

This level is "0" if the delay generator is off (DELAY control in the centre-position); and "1" if the generator is on. Check the frequency at D1356 p. 9.
The frequency must be approximately 1 Hz when the DELAY-control is rotated out of the centre-position and the generator just starts running. The maximum frequency is approximately 50 Hz.

. **Gap R1389**

This potentiometer controls the width of the generator-off range of DELAY control.
Check the level on D1357 p. 3, as indicated under R1408.
This "off" range must be approximately 30 degrees centered around the STOP position.

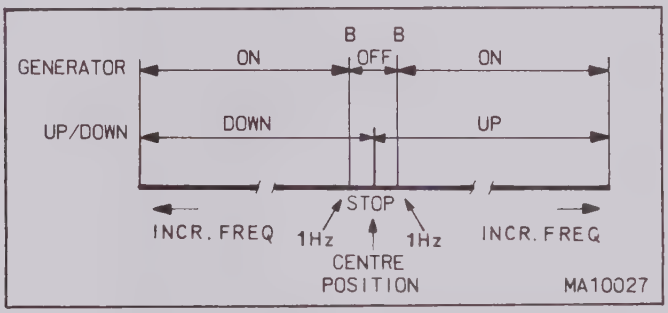


Fig. 4.2. Control range DELAY pot. meter (R4)

4.5. VARIOUS

. **DAC ref. voltage, R1328**

This potentiometer controls the reference voltage for the digital to-analog convertors D1313, D1314, D1336 and D1337.
This voltage influences the deflection of the c.r.t. in both X and Y directions.
Check that this voltage measured on test-point V_{out} is +7 V (+ or −14 mV).

. **100 MHz oscillator, C1061**

If necessary adjust this capacitor to set the frequency to 100 MHz (+ or − 1 %).
If no 100 MHz counter is available also the frequencies in the divide circuits can be measured.

. **C.R.T. circuit**

This potentiometer R1148 (H.T. ADJ.) controls the high-tension for the c.r.t.
Measure the cathode voltage of the c.r.t. (pin 7 of the socket).
This voltage must be −2000 V (+ or −20 V).

. **Intensity range R1169 (INT.)**

This potentiometer is the pre-set for the intensity control on the front panel.
If necessary adjust R1169 so, that the control range of the intensity control is as indicated in fig. 4.3.

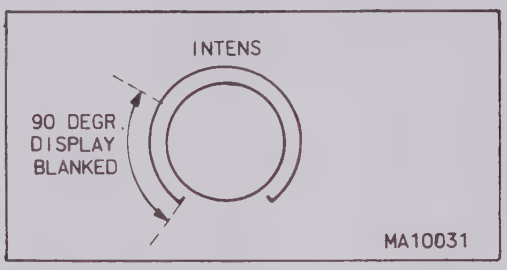


Fig. 4.3. Control range INTENSITY pot. meter

. **Trace rotation R1189**

This potentiometer allows rotative adjustment of the display on the c.r.t.

. **Barrel-cushion distortion R1188.**

Compensation of this kind of distortion of the c.r.t.'s display is possible with R1188.

. **Astigmatism R1134**

Distortion of the spot which generates the display on the c.r.t. can be compensated by correct setting of this potentiometer.

Note that distortion (R1188), astigmatism (R1134) and the Focus control at the front panel, may influence each other. So check the settings of all these potentiometers for optimum picture quality at medium brightness setting.

. **Balance**

Display positioning is done by potentiometers R1217, 1218, 1259, 1261 located on the X, Y, Z control board.
Small shifts of the display are possible with this potentiometers.
For the complete adjustment proceed as follows:

– Balance X-deflection, R1217, R1218
  . Remove the coax. cables from plug-sockets 444 and 555.
  . Connect the centre pin of these sockets each with a 3300 ohms resistor to gnd.
  . Adjust R1217 and R1218 so, that the voltage on the X-deflection plates is +75 V with respect to gnd.

– Balance Y-deflection, R1259, R1261
  . Remove the coax. cables from plug-sockets 000 and 111.
  . Connect the centre pin of these sockets with a 2700 ohm resistor to gnd.
  . Adjust R1259 and R1261 sothat the voltage on the Y-deflection plates is + 22,5 V with respect to gnd.

– Trigger glitch suppression R925, R930, R955, R960, R975.

These potentiometers control the filter time of the trigger glitch suppression filters.

Put these potentiometers always in the "0 ohm" position.
Note : In this instrument 0 ohm is fully clockwise.

5. Parts lists

5.1. Complete Units

Unit	*Order number*	*Description*	
A2	5322 216 25672	16-channel input unit	(100 MHz-version)
A3	5322 216 25671	Clock, and Trigger unit	(100 MHz-version)
A4	5322 216 25417	C.r.t. drive unit	(X, Y, Z ampl.)
A5	5322 216 25418	Micro-processor unit	(PM 3500/01-02
	5322 216 25673	Micro-processor unit	(PM 3500/03-04-05
A6	5322 216 25419	Data-memory unit	
A7	5322 216 25421	Focus unit	
A8	5322 216 25422	Primary unit power supply	
A9	5322 216 25423	Secondary unit power supply	
A15	5322 219 84132	E.h.t. unit	

Micro processor unit

The main difference between both units is the character generator D1321.
In PM 3500/01/02 this is a 2150–2516 PROM (service code 5322 209 86117).
In PM 3500/03 .. /04 this is a 2716 EPROM (service code 5322 209 14783).
These I.C.'s are not pin-compatible.
Also the threshold selection for the EXT TRIG/TRIG QUAL and CLOCK QUAL input circuits on the PM 3500/03 .. /05 has been extended with two jumpers X1312 and X1313.

The /03-/05 unit may be used as a replacement part for the PM 3500/01/02 instruments.
Only the wiring between X1307 at the micro-processor unit and X903 at the clock trigger unit must be adapted, due to the modification of the threshold selection circuit. Refer to the circuit diagrams.

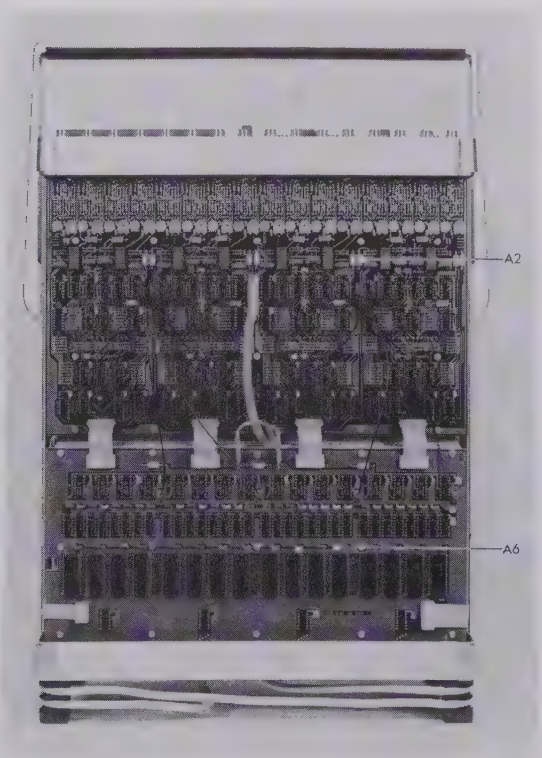


Fig. 5.1.a. Bottom view

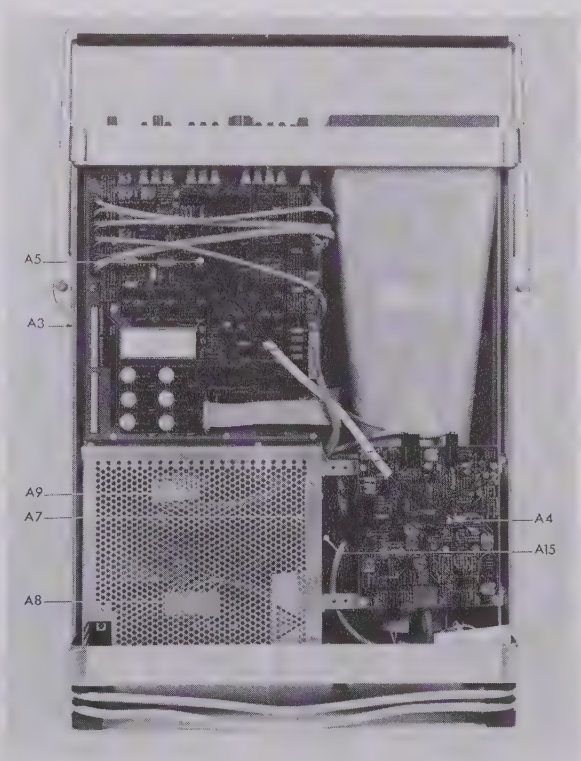


Fig. 5.1.b. Top view

5.2. Mechanical parts

Item	Qty	Order number	Description
Frontpanel			
1	1	5322 498 54098	Carrying handle; consisting of two side pieces, carrying handle and four M3 screws (use locking-agent when securing the screws)
	1	5322 455 24003	Blue text strip in carrying handle
	1	5322 460 64051	Plastic profile of carrying handle
	2	5322 528 34113	Round locking piece
	2	5322 535 74401	Locking pin in side piece
	2	5322 492 54155	Spring for locking pin
2	4	5322 462 44297	Rubber foot in bottom plate
3	1	5322 447 94565	Bottom cover plate compl.
4	1	5322 447 94564	Top cover plate compl.
5	2	5322 460 64042	Profiled side beam
	8	5322 532 14174	Tap screw fixing the side beams to front- and rear units
6	4	5322 460 64048	Corner piece
7	4	5322 460 64047	Rim piece
8	8	5322 417 24024	Quick fastener complete
9	1	5322 459 24095	Bezel
10	1	5322 480 34096	Contrast plate
11	1	5322 456 94093	Text plate (100 MHz)
12	1	5322 276 54038	Push-button switch assy*)
	36	5322 414 14011	Knob of push-button switch
13	1	5322 276 64038	Push-button switch assy complete
14	1	5322 276 54039	Push-button switch assy*)
15	1	5322 276 64037	Push-button switch assy*)
16	1	5322 276 54041	Push-button switch assy complete
17	1	5322 276 14381	Push-button switch*)
18	1	5322 276 74024	Push-button switch assy*)
19	2	5322 264 24015	Calibration terminal pin
	2	5322 325 84013	Isolation grommet
20	3	5322 414 34223	Knob, 4 mm shaft
	3	5322 492 64337	Clamping ring for knob
	3	5322 414 74015	Knob cover with dash
21	1	5322 414 34081	Knob, 6 mm shaft
	1	5322 414 74022	Knob cover with dash
22	1	5322 414 34091	Clamp knob, 4 mm shaft
	1	5322 414 74028	Knob skirt
	1	5322 414 74015	Knob cover with dash
23	16	5322 271 34218	3-position tumbler switch
24	20	5322 267 10004	BNC connector

*) Without knobs

Item	Qty	Order number	Description
Rear panel			
25	4	5322 462 44425	Rear foot assy
26	1	4822 272 10079	Mains voltage adaptor
27	1	5322 456 94086	Plastic plate
28	1	5322 321 14071	Mains cable compl.
29	1	5322 325 64061	Cable clamp
30	1	5322 466 85168	Earth connection block
31	2	5322 256 34081	Fuse holder
Inside the instrument			
–	50	5322 462 44417	Plastic spacer 1)
–	15	5322 532 54341	Hard-paper washer 1)
–	20	4822 505 10029	Square nut M3 (in the profiled side beams)
–	4	5322 256 94069	Mounting clamp for capacitors C1802, C1803 in the power supply unit
–	1	5322 532 74014	C.r.t. rubber sleeve
–	4	5322 466 64198	Clamping piece c.r.t. front
–	1	5322 320 14105	E.h.t. cable for c.r.t.
–	1	5322 535 94941	Shaft INTENS, pot, meter
–	1	5322 532 24398	Coupling piece for above shaft
–	12	5322 401 14191	Key for CIS connectors

1) These parts are used e.g. to fix the μP-print on the U-profiles.

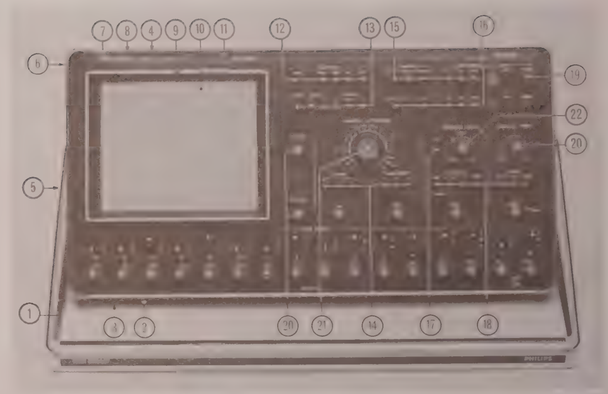


Fig. 5.2. Front view

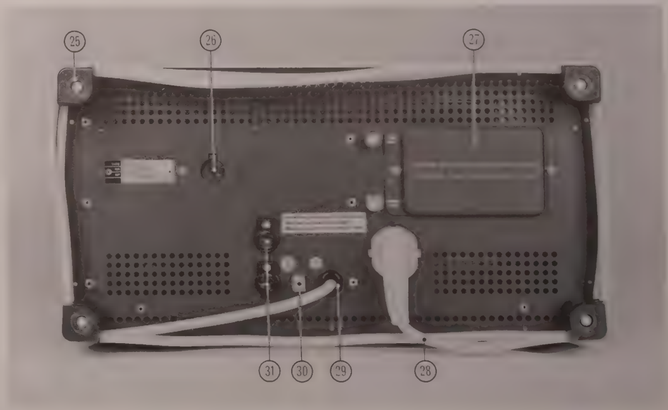


Fig. 5.3. Rear view

5.3. ELECTRICAL PARTS

Item numbers have been divided in groups, which relate to the circuits and units, as indicated in following table.

Item no	*Unit or location*		*Unit no*
1 ... 99	Front panel		–
100 ...	Ch. 0, 1		
200 ...	Ch. 2, 3		
300 ...	Ch. 4, 5		
400 ...	Ch. 6, 7	Data input unit	A2
500 ...	Ch. 8, 9		
600 ...	Ch. 10, 11		
700 ...	Ch. 12, 13		
800 ...	Ch. 14, 15		
900 ...	Clock, trigger unit		A3
1100 ...	C.r.t. drive (X, Y, Z)		A4
1300 ...	Micro-processor unit		A5
1500 ...	Data memory unit		A6
	Focus unit		A7
1800 ...	Power supply prim. unit		A8
1861 ...	Power supply sec. unit		A9
	C.r.t. socket		A10
	Aux. unit c.r.t.		A11
	10 kV multipl. rectifier		A15

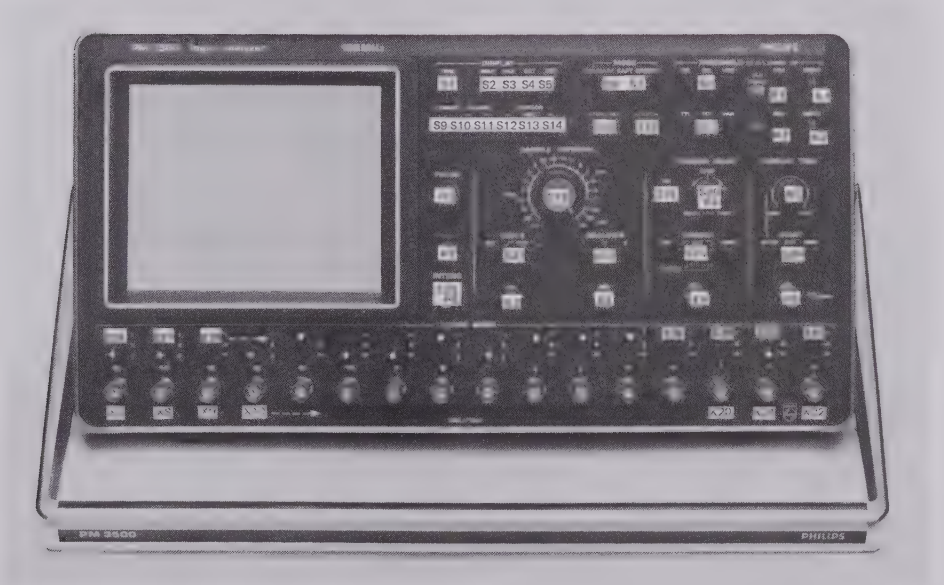


Fig. 5.4. Electrical item no's at front panel

VARIOUS ELECTRICAL PARTS

Item	*Ordernumber*	*Description*
Xtal		
B1061	5322 242 74368	100 MHz
Cathode ray tube		
V1	5322 131 24057	D18 - 120 GH
Led		
V2	5322 130 34595	Light emitting diode
Transformers		
T1801	5322 146 34109	Chopper transformer
T1851	5322 146 34108	42 : 50 + 50 + 100 : 8 : 1125 0,28 : 191 : 0,1 : 470 ohms
Coils		
L1101	5322 150 14015	c.r.t. coil 432 ohms
L1061, 1062	4322 057 03371	0,33 mH 0,17 ohms
L1801, 1802	5322 152 24069	70 μH 0,15 ohms
L1803	5322 142 44026	1 : 4,5 1,9 : 7 ohms
L1804	5322 281 64154	144 μH 0,28 ohms
L1806	5322 148 84041	1 + 1 : 2 0,05 + 0,05 : 1,4 ohms
L1807	5322 152 24062	36 mH 80 ohms
L1863 ... 1866	5322 152 24082	10 μH 0,01 ohms
L1867 ... 1869	4822 156 20663	470 μH 0,5 ohms
Mains filter		
Z26	5322 121 44134	
Fuses		
F1, 2	4822 253 30027	3,15 amps delayed action (for both 110 V and 220 V mains ranges)
Switch		
S18	5322 273 84034	Sample interval switch complete

ITEM	ORDERING NUMBER	FARAD	TOL (%)	VOLTS	REMARKS
CAPACITORS					
C 1	5322 122 14031				CERAMIC TUBULAR
C 101	4822 124 20678	47UF	-10+50	10	ELECTROLYTIC
C 102	4822 124 20688	33UF	-10+50	16	ELECTROLYTIC
C 103	4822 122 31188	3,3PF	0,25PF	500	CERAMIC PLATE
C 104	4822 122 31081	100PF	2	500	CERAMIC PLATE
C 105	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 106	4822 122 31047	5,6PF	0,25PF	100	CERAMIC PLATE
C 107	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 108	4822 122 31116	2,2NF	-20+80	40	CERAMIC PLATE
C 109	4822 122 30027	1NF	10	100	CERAMIC PLATE
C 110	4822 122 31047	5,6PF	0,25PF	100	CERAMIC PLATE
C 111	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 112	4822 122 31036	2,2PF	0,25PF	100	CERAMIC PLATE
C 113	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 114	4822 121 40427	220NF	10		POLYESTER FOIL
C 115	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 116	4822 121 40427	220NF	10		POLYESTER FOIL
C 117	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 118	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 119	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 120	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 121	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 124	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 125	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 126	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 127	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 128	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 129	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 153	4822 122 31188	3,3PF	0,25PF	500	CERAMIC PLATE
C 154	4822 122 31081	100PF	2	500	CERAMIC PLATE
C 155	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 156	4822 122 31047	5,6PF	0,25PF	100	CERAMIC PLATE
C 157	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 158	4822 122 31116	2,2NF	-20+80	40	CERAMIC PLATE
C 159	4822 122 30027	1NF	10	100	CERAMIC PLATE
C 160	4822 122 31047	5,6PF	0,25PF	100	CERAMIC PLATE
C 161	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 162	4822 122 31036	2,2PF	0,25PF	100	CERAMIC PLATE
C 163	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 164	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 165	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 166	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 167	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 168	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 169	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 177	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 178	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 203	4822 122 31188	3,3PF	0,25PF	500	CERAMIC PLATE
C 204	4822 122 31081	100PF	2	500	CERAMIC PLATE
C 205	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 206	4822 122 31047	5,6PF	0,25PF	100	CERAMIC PLATE
C 207	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 208	4822 122 31116	2,2NF	-20+80	40	CERAMIC PLATE
C 209	4822 122 30027	1NF	10	100	CERAMIC PLATE
C 210	4822 122 31047	5,6PF	0,25PF	100	CERAMIC PLATE
C 211	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 212	4822 122 31036	2,2PF	0,25PF	100	CERAMIC PLATE
C 213	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 214	4822 121 40427	220NF	10		POLYESTER FOIL
C 215	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 216	4822 121 40427	220NF	10		POLYESTER FOIL
C 217	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 218	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 219	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 220	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 226	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 227	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 228	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE

ITEM	ORDERING NUMBER	FARAD	TOL (%)	VOLTS	REMARKS
C 253	4822 122 31188	3,3PF	0,25PF	500	CERAMIC PLATE
C 254	4822 122 31081	100PF	2	500	CERAMIC PLATE
C 256	4822 122 31047	5,6PF	0,25PF	100	CERAMIC PLATE
C 257	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 258	4822 122 31116	2,2NF	-20+80	40	CERAMIC PLATE
C 259	4822 122 30027	1NF	10	100	CERAMIC PLATE
C 260	4822 122 31047	5,6PF	0,25PF	100	CERAMIC PLATE
C 261	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 262	4822 122 31036	2,2PF	0,25PF	100	CERAMIC PLATE
C 263	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 264	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 265	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 266	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 267	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 268	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 269	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 270	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 271	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 272	4822 124 20671	68UF	-10+50	6,3	ELECTROLYTIC
C 273	4822 124 20671	68UF	-10+50	6,3	ELECTROLYTIC
C 274	4822 124 20671	68UF	-10+50	6,3	ELECTROLYTIC
C 275	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 276	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 277	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 278	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 279	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 280	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 301	4822 124 20678	47UF	-10+50	10	ELECTROLYTIC
C 302	4822 124 20688	33UF	-10+50	16	ELECTROLYTIC
C 303	4822 122 31188	3,3PF	0,25PF	500	CERAMIC PLATE
C 304	4822 122 31081	100PF	2	500	CERAMIC PLATE
C 305	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 306	4822 122 31047	5,6PF	0,25PF	100	CERAMIC PLATE
C 307	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 308	4822 122 31116	2,2NF	-20+80	40	CERAMIC PLATE
C 309	4822 122 30027	1NF	10	100	CERAMIC PLATE
C 310	4822 122 31047	5,6PF	0,25PF	100	CERAMIC PLATE
C 311	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 312	4822 122 31036	2,2PF	0,25PF	100	CERAMIC PLATE
C 313	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 314	4822 121 40427	220NF	10		POLYESTER FOIL
C 315	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 316	4822 121 40427	220NF	10		POLYESTER FOIL
C 317	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 318	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 319	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 320	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 321	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 324	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 325	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 326	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 327	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 328	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 329	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 353	4822 122 31188	3,3PF	0,25PF	500	CERAMIC PLATE
C 354	4822 122 31081	100PF	2	500	CERAMIC PLATE
C 355	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 356	4822 122 31047	5,6PF	0,25PF	100	CERAMIC PLATE
C 357	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 358	4822 122 31116	2,2NF	-20+80	40	CERAMIC PLATE
C 359	4822 122 30027	1NF	10	100	CERAMIC PLATE
C 360	4822 122 31047	5,6PF	0,25PF	100	CERAMIC PLATE
C 361	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 362	4822 122 31036	2,2PF	0,25PF	100	CERAMIC PLATE
C 363	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 364	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 365	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 366	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 367	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 368	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE

ITEM	ORDERING NUMBER	FARAD	TOL (%)	VOLTS	REMARKS
C 369	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 377	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 378	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 403	4822 122 31188	3,3PF	0,25PF	500	CERAMIC PLATE
C 404	4822 122 31081	100PF	2	500	CERAMIC PLATE
C 405	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 406	4822 122 31047	5,6PF	0,25PF	100	CERAMIC PLATE
C 407	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 408	4822 122 31116	2,2NF	-20+80	40	CERAMIC PLATE
C 409	4822 122 30027	1NF	10	100	CERAMIC PLATE
C 410	4822 122 31047	5,6PF	0,25PF	100	CERAMIC PLATE
C 411	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 412	4822 122 31036	2,2PF	0,25PF	100	CERAMIC PLATE
C 413	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 414	4822 121 40427	220NF	10	100	POLYESTER FOIL
C 415	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 416	4822 121 40427	220NF	10	100	POLYESTER FOIL
C 417	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 418	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 419	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 420	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 426	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 427	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 428	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 453	4822 122 31188	3,3PF	0,25PF	500	CERAMIC PLATE
C 454	4822 122 31081	100PF	2	500	CERAMIC PLATE
C 456	4822 122 31047	5,6PF	0,25PF	100	CERAMIC PLATE
C 457	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 458	4822 122 31116	2,2NF	-20+80	40	CERAMIC PLATE
C 459	4822 122 30027	1NF	10	100	CERAMIC PLATE
C 460	4822 122 31047	5,6PF	0,25PF	100	CERAMIC PLATE
C 461	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 462	4822 122 31036	2,2PF	0,25PF	100	CERAMIC PLATE
C 463	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 464	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 465	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 466	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 467	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 468	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 469	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 470	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 471	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 472	4822 124 20671	68UF	-10+50	6,3	ELECTROLYTIC
C 473	4822 124 20671	68UF	-10+50	6,3	ELECTROLYTIC
C 474	4822 124 20671	68UF	-10+50	6,3	ELECTROLYTIC
C 475	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 476	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 477	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 478	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 501	4822 124 20678	47UF	-10+50	10	ELECTROLYTIC
C 502	4822 124 20688	33UF	-10+50	16	ELECTROLYTIC
C 503	4822 122 31188	3,3PF	0,25PF	500	CERAMIC PLATE
C 504	4822 122 31081	100PF	2	500	CERAMIC PLATE
C 505	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 506	4822 122 31047	5,6PF	0,25PF	100	CERAMIC PLATE
C 507	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 508	4822 122 31116	2,2NF	-20+80	40	CERAMIC PLATE
C 509	4822 122 30027	1NF	10	100	CERAMIC PLATE
C 510	4822 122 31047	5,6PF	0,25PF	100	CERAMIC PLATE
C 511	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 512	4822 122 31036	2,2PF	0,25PF	100	CERAMIC PLATE
C 513	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 514	4822 121 40427	220NF	10	100	POLYESTER FOIL
C 515	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 516	4822 121 40427	220NF	10	100	POLYESTER FOIL
C 517	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 518	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 519	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 520	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 521	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE

ITEM	ORDERING NUMBER	FARAD	TOL (%)	VOLTS	REMARKS
C 524	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 525	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 526	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 527	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 528	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 529	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 553	4822 122 31188	3,3PF	0,25PF	500	CERAMIC PLATE
C 554	4822 122 31081	100PF	2	500	CERAMIC PLATE
C 555	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 556	4822 122 31047	5,6PF	0,25PF	100	CERAMIC PLATE
C 557	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 558	4822 122 31116	2,2NF	-20+80	40	CERAMIC PLATE
C 559	4822 122 30027	1NF	10	100	CERAMIC PLATE
C 560	4822 122 31047	5,6PF	0,25PF	100	CERAMIC PLATE
C 561	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 562	4822 122 31036	2,2PF	0,25PF	100	CERAMIC PLATE
C 563	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 564	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 565	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 566	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 567	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 568	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 569	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 577	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 578	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 603	4822 122 31188	3,3PF	0,25PF	500	CERAMIC PLATE
C 604	4822 122 31081	100PF	2	500	CERAMIC PLATE
C 605	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 606	4822 122 31047	5.6PF	0,25PF	100	CERAMIC PLATE
C 607	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 608	4822 122 31116	2,2NF	-20+80	40	CERAMIC PLATE
C 609	4822 122 30027	1NF	10	100	CERAMIC PLATE
C 610	4822 122 31047	5,6PF	0,25PF	100	CERAMIC PLATE
C 611	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 612	4822 122 31036	2,2PF	0,25PF	100	CERAMIC PLATE
C 613	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 614	4822 121 40427	220NF	10	10	POLYESTER FOIL
C 615	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 616	4822 121 40427	220NF	10	10	POLYESTER FOIL
C 617	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 618	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 619	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 620	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 626	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 627	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 628	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 653	4822 122 31188	3,3PF	0,25PF	500	CERAMIC PLATE
C 654	4822 122 31081	100PF	2	500	CERAMIC PLATE
C 656	4822 122 31047	5,6PF	0,25PF	100	CERAMIC PLATE
C 657	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 658	4822 122 31116	2,2NF	-20+80	40	CERAMIC PLATE
C 659	4822 122 30027	1NF	10	100	CERAMIC PLATE
C 660	4822 122 31047	5,6PF	0,25PF	100	CERAMIC PLATE
C 661	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 662	4822 122 31036	2,2PF	0,25PF	100	CERAMIC PLATE
C 663	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 668	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 669	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 670	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 671	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 672	4822 124 20671	68UF	-10+50	6,3	ELECTROLYTIC
C 673	4822 124 20671	68UF	-10+50	6,3	ELECTROLYTIC
C 674	4822 124 20671	68UF	-10+50	6,3	ELECTROLYTIC
C 675	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 676	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 677	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 678	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 701	4822 124 20678	47UF	-10+50	10	ELECTROLYTIC
C 702	4822 124 20688	33UF	-10+50	16	ELECTROLYTIC
C 703	4822 122 31188	3,3PF	0,25PF	500	CERAMIC PLATE

ITEM	ORDERING NUMBER	FARAD	TOL (%)	VOLTS	REMARKS
C 704	4822 122 31081	100PF	2	500	CERAMIC PLATE
C 705	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 706	4822 122 31047	5,6PF	0,25PF	100	CERAMIC PLATE
C 707	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 708	4822 122 31116	2,2NF	-20+80	40	CERAMIC PLATE
C 709	4822 122 30027	1NF	10	100	CERAMIC PLATE
C 710	4822 122 31047	5,6PF	0,25PF	100	CERAMIC PLATE
C 711	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 712	4822 122 31036	2,2PF	0,25PF	100	CERAMIC PLATE
C 713	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 714	4822 121 40427	220NF	10	10	POLYESTER FOIL
C 715	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 716	4822 121 40427	220NF	10	10	POLYESTER FOIL
C 717	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 718	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 719	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 720	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 721	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 722	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 723	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 724	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 725	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 726	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 727	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 728	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 729	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 753	4822 122 31188	3,3PF	0,25PF	500	CERAMIC PLATE
C 754	4822 122 31081	100PF	2	500	CERAMIC PLATE
C 755	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 756	4822 122 31047	5,6PF	0,25PF	100	CERAMIC PLATE
C 757	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 758	4822 122 31116	2,2NF	-20+80	40	CERAMIC PLATE
C 759	4822 122 30027	1NF	10	100	CERAMIC PLATE
C 760	4822 122 31047	5,6PF	0,25PF	100	CERAMIC PLATE
C 761	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 762	4822 122 31036	2,2PF	0,25PF	100	CERAMIC PLATE
C 763	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 764	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 765	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 766	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 767	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 768	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 769	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 777	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 778	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 801	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 803	4822 122 31188	3,3PF	0,25PF	500	CERAMIC PLATE
C 804	4822 122 31081	100PF	2	500	CERAMIC PLATE
C 805	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 806	4822 122 31047	5,6PF	0,25PF	100	CERAMIC PLATE
C 808	4822 122 31116	2,2NF	-20+80	40	CERAMIC PLATE
C 809	4822 122 30027	1NF	10	100	CERAMIC PLATE
C 810	4822 122 31047	5,6PF	0,25PF	100	CERAMIC PLATE
C 811	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 812	4822 122 31036	2,2PF	0,25PF	100	CERAMIC PLATE
C 813	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 814	4822 121 40427	220NF	10	10	POLYESTER FOIL
C 815	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 816	4822 121 40427	220NF	10	10	POLYESTER FOIL
C 817	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 818	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 819	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 820	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 826	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 827	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 828	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 853	4822 122 31188	3,3PF	0,25PF	500	CERAMIC PLATE
C 854	4822 122 31081	100PF	2	500	CERAMIC PLATE
C 856	4822 122 31047	5,6PF	0,25PF	100	CERAMIC PLATE
C 857	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE

ITEM	ORDERING NUMBER	FARAD	TOL (%)	VOLTS	REMARKS
C 858	4822 122 31116	2,2NF	-20+80	40	CERAMIC PLATE
C 859	4822 122 30027	1NF	10	100	CERAMIC PLATE
C 860	4822 122 31047	5,6PF	0,25PF	100	CERAMIC PLATE
C 861	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 862	4822 122 31036	2,2PF	0,25PF	100	CERAMIC PLATE
C 863	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 864	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 865	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 866	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 867	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 868	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 869	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 870	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 871	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 872	4822 124 20671	68UF	-10+50	6,3	ELECTROLYTIC
C 873	4822 124 20671	68UF	-10+50	6,3	ELECTROLYTIC
C 874	4822 124 20671	68UF	-10+50	6,3	ELECTROLYTIC
C 875	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 876	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 877	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 878	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 879	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 880	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 901	4822 122 31188	3,3PF	0,25PF	500	CERAMIC PLATE
C 902	4822 122 31081	100PF	2	500	CERAMIC PLATE
C 903	4822 122 31047	5,6PF	0,25PF	100	CERAMIC PLATE
C 904	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 905	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 906	4822 122 31116	2,2NF	-20+80	40	CERAMIC PLATE
C 907	4822 122 30027	1NF	10	100	CERAMIC PLATE
C 908	4822 122 31047	5,6PF	0,25PF	100	CERAMIC PLATE
C 909	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 910	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 911	4822 122 31036	2,2PF	0,25PF	100	CERAMIC PLATE
C 912	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 913	4822 121 40427	220NF	10	100	POLYESTER FOIL
C 914	4822 121 40427	220NF	10	100	POLYESTER FOIL
C 915	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 916	4822 122 31188	3,3PF	0,25PF	500	CERAMIC PLATE
C 917	4822 122 31081	100PF	2	500	CERAMIC PLATE
C 918	4822 122 31047	5,6PF	0,25PF	100	CERAMIC PLATE
C 919	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 920	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 921	4822 122 31116	2,2NF	-20+80	40	CERAMIC PLATE
C 922	4822 122 30027	1NF	10	100	CERAMIC PLATE
C 923	4822 122 31047	5,6PF	0,25PF	100	CERAMIC PLATE
C 924	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 926	4822 122 31036	2,2PF	0,25PF	100	CERAMIC PLATE
C 927	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 928	4822 124 20678	47UF	-10+50	10	ELECTROLYTIC
C 929	4822 124 20688	33UF	-10+50	16	ELECTROLYTIC
C 931	4822 122 31188	3,3PF	0,25PF	500	CERAMIC PLATE
C 932	4822 122 31081	100PF	2	500	CERAMIC PLATE
C 933	4822 122 31047	5,6PF	0,25PF	100	CERAMIC PLATE
C 934	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 936	4822 122 31116	2,2NF	-20+80	40	CERAMIC PLATE
C 937	4822 122 30027	1NF	10	100	CERAMIC PLATE
C 938	4822 122 31047	5,6PF	0,25PF	100	CERAMIC PLATE
C 939	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 940	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 941	4822 122 31036	2,2PF	0,25PF	100	CERAMIC PLATE
C 942	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 943	4822 121 40427	220NF	10	100	POLYESTER FOIL
C 944	4822 121 40427	220NF	10	100	POLYESTER FOIL
C 946	4822 121 40427	220NF	10	100	POLYESTER FOIL
C 947	4822 122 31058	15PF	2	100	CERAMIC PLATE
C 948	4822 122 31229	15PF	2	100	CERAMIC PLATE
C 949	4822 122 31058	15PF	2	100	CERAMIC PLATE
C 951	4822 122 31058	15PF	2	100	CERAMIC PLATE
C 952	4822 122 31058	15PF	2	100	CERAMIC PLATE

ITEM	ORDERING NUMBER	FARAD	TOL (%)	VOLTS	REMARKS
C 953	4822 122 31058	15PF	2	100	CERAMIC PLATE
C 954	4822 122 31058	15PF	2	100	CERAMIC PLATE
C 956	4822 124 20678	47UF	-10+50	10	ELECTROLYTIC
C 957	4822 124 20678	47UF	-10+50	10	ELECTROLYTIC
C 958	4822 124 20678	47UF	-10+50	10	ELECTROLYTIC
C 959	4822 122 31316	100PF	2	100	CERAMIC PLATE
C 960	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 965	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 967	4822 122 31058	15PF	2	100	CERAMIC PLATE
C 968	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 970	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 971	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 972	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 973	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 974	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 975	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 976	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 977	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 978	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 979	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 981	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 982	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 983	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 984	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 985	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 986	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 987	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 988	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 989	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 991	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 992	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 993	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 994	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 995	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 996	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 997	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 998	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 999	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1001	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1002	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1003	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1004	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1005	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1006	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1007	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1008	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1009	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1011	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1012	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1013	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1014	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1015	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1016	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1017	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1018	4822 124 20728	10UF	-10+50	63	ELECTROLYTIC
C 1019	4822 124 20728	10UF	-10+50	63	ELECTROLYTIC
C 1021	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1022	4822 122 31069	39PF	2	100	CERAMIC PLATE
C 1023	4822 122 31069	39PF	2	100	CERAMIC PLATE
C 1024	4822 122 31069	39PF	2	100	CERAMIC PLATE
C 1026	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1027	4822 122 31069	39PF	2	100	CERAMIC PLATE
C 1029	4822 122 31069	39PF	2	100	CERAMIC PLATE
C 1061	5322 125 50048	3,5PF		300	TRIMMER
C 1063	4822 122 31213	0,68PF	0,25PF	500	CERAMIC PLATE
C 1064	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1066	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1067	4822 122 31058	15PF	2	100	CERAMIC PLATE
C 1068	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1069	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE

ITEM	ORDERING NUMBER	FARAD	TOL (%)	VOLTS	REMARKS
C 1070	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1071	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1072	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1073	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1074	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1075	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1076	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1077	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1078	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1079	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1081	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1082	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1101	4822 122 31054	10PF	2	100	CERAMIC PLATE
C 1102	4822 122 31054	10PF	2	100	CERAMIC PLATE
C 1103	4822 122 31054	10PF	2	100	CERAMIC PLATE
C 1104	4822 122 31054	10PF	2	100	CERAMIC PLATE
C 1105	4822 121 41161	100NF	10	250	POLYESTER FOIL
C 1106	4822 124 20728	10UF	-10+50	63	ELECTROLYTIC
C 1107	4822 122 31054	10PF	2	100	CERAMIC PLATE
C 1108	4822 121 41161	100NF	10	250	POLYESTER FOIL
C 1109	4822 122 31414	10NF	-20+50	100	CERAMIC PLATE
C 1111	4822 121 41161	100NF	10	250	POLYESTER FOIL
C 1112	5322 122 50001	4,7NF	-20+50	3K	CERAMIC DISK
C 1113	4822 122 31414	10NF	-20+50	100	CERAMIC PLATE
C 1114	4822 122 31414	10NF	-20+50	100	CERAMIC PLATE
C 1115	5322 122 50001	4,7NF	-20+50	3K	CERAMIC DISK
C 1116	4822 122 31414	10NF	-20+50	100	CERAMIC PLATE
C 1117	4822 121 41161	100NF	10	250	POLYESTER FOIL
C 1118	5322 122 50001	4,7NF	-20+50	3K	CERAMIC DISK
C 1119	5322 122 50001	4,7NF	-20+50	3K	CERAMIC DISK
C 1120	4822 122 31041	3,3PF	0,25PF	100	CERAMIC PLATE
C 1121	5322 122 30134	10NF	-20+50	3K	CERAMIC PLATE
C 1122	5322 122 54007	220PF	− 20 + 50	3K	CERAMIC DISK
C 1123	5322 122 50001	4,7NF	-20+50	3K	CERAMIC DISK
C 1124	4822 122 31414	10NF	-20+50	100	CERAMIC PLATE
C 1125	5322 122 50001	4,7NF	-20+50	3K	CERAMIC DISK
C 1126	5322 121 54087	1,8 NF	1	63	POLYSTYRENE FOIL
C 1127	4822 121 40366	15NF	10	1K	POLYESTER FOIL
C 1128	4822 122 30128	4,7NF	10	100	CERAMIC PLATE
C 1129	5322 122 50044	1NF	-20+50	3K	CERAMIC DISK
C 1130	4822 122 31211	100PF	10	500	CERAMIC PLATE
C 1131	5322 122 50044	1NF	-20+50	3K	CERAMIC DISK
C 1132	4822 122 31414	10NF	-20+50	100	CERAMIC PLATE
C 1133	4822 124 20728	10UF	-10+50	63	ELECTROLYTIC
C 1134	4822 124 20728	10UF	-10+50	63	ELECTROLYTIC
C 1135	4822 122 31178	680PF	10	500	CERAMIC PLATE
C 1136	4822 124 20728	10UF	-10+50	63	ELECTROLYTIC
C 1137	4822 122 31414	10NF	-20+50	100	CERAMIC PLATE
C 1138	4822 122 31414	10NF	-20+50	100	CERAMIC PLATE
C 1139	4822 121 41134	10NF	10	250	POLYESTER FOIL
C 1201	4822 122 30105	1,5PF	0,25PF	100	CERAMIC PLATE
C 1202	4822 122 31175	1NF	10	500	CERAMIC PLATE
C 1203	4822 122 31175	1NF	10	500	CERAMIC PLATE
C 1204	4822 122 31414	10NF	-20+50	100	CERAMIC PLATE
C 1206	4822 122 31414	10NF	-20+50	100	CERAMIC PLATE
C 1207	4822 122 30105	1,5PF	0,25PF	100	CERAMIC PLATE
C 1208	4822 122 31175	1NF	10	500	CERAMIC PLATE
C 1209	4822 122 31175	1NF	10	500	CERAMIC PLATE
C 1251	4822 122 31049	6,8PF	0,25PF	100	CERAMIC PLATE
C 1252	4822 122 31414	10NF	-20+50	100	CERAMIC PLATE
C 1253	4822 122 31414	10NF	-20+50	100	CERAMIC PLATE
C 1254	4822 122 31414	10NF	-20+50	100	CERAMIC PLATE
C 1256	4822 122 31049	6,8PF	0,25PF	100	CERAMIC PLATE
C 1301	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1302	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1303	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1304	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1305	4822 122 31168	270PF	10	100	CERAMIC PLATE
C 1306	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1307	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE

ITEM	ORDERING NUMBER	FARAD	TOL (%)	VOLTS	REMARKS
C 1308	4822 121 40522				POLYESTER FOIL
C 1309	4822 121 40522				POLYESTER FOIL
C 1310	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1311	4822 124 20728	10UF	-10+50	63	ELECTROLYTIC
C 1312	4822 124 20728	10UF	-10+50	63	ELECTROLYTIC
C 1313	4822 121 40522				POLYESTER FOIL
C 1314	4822 124 20728	10UF	-10+50	63	ELECTROLYTIC
C 1315	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1316	4822 121 40522	100NF	10	100	POLYESTER FOIL
C 1317	4822 121 40522	100NF	10	100	POLYESTER FOIL
C 1318	4822 121 41134	10NF	10	250	POLYESTER FOIL
C 1319	4822 121 40522	100NF	10	100	POLYESTER FOIL
C 1321	4822 121 41134	10NF	10	250	POLYESTER FOIL
C 1322	4822 121 40522	100NF	10	100	POLYESTER FOIL
C 1323	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1324	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1326	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1327	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1329	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1332	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1333	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1334	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1336	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1337	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1338	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1339	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1341	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1342	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1343	4822 124 20725	3,3UF	-10+50	63	ELECTROLYTIC
C 1344	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1346	4822 124 20688	33UF	-10+50	16	ELECTROLYTIC
C 1347	4822 124 20688	33UF	-10+50	16	ELECTROLYTIC
C 1348	4822 124 20688	33UF	-10+50	16	ELECTROLYTIC
C 1349	4822 124 20688	33UF	-10+50	16	ELECTROLYTIC
C 1357	4822 121 40522	100NF	10	100	POLYESTER FOIL
C 1358	4822 121 41134	10NF	10	250	POLYESTER FOIL
C 1359	4822 121 40522	100NF	10	100	POLYESTER FOIL
C 1360	4822 122 31168	270PF	10	100	CERAMIC PLATE
C 1361	4822 121 40522	100NF	10	100	POLYESTER FOIL
C 1362	4822 121 41134	10NF	10	250	POLYESTER FOIL
C 1363	4822 121 40522	100NF	10	100	POLYESTER FOIL
C 1364	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1365	4822 122 31168	270PF	10	100	CERAMIC PLATE
C 1366	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1367	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1368	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1369	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1370	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1371	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1372	4822 124 20725	3,3UF	-10+50	63	ELECTROLYTIC
C 1373	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1374	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1376	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1377	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1378	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1379	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1381	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1382	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1383	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1384	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1386	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1387	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1388	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1431	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1432	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1433	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1451	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1452	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1453	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1501	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE

ITEM	ORDERING NUMBER	FARAD	TOL (%)	VOLTS	REMARKS
C 1502	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1503	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1504	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1506	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1507	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1508	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1509	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1511	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1512	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1513	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1514	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1516	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1517	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1518	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1519	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1521	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1522	4822 124 20678	47UF	-10+50	10	ELECTROLYTIC
C 1523	4822 124 20678	47UF	-10+50	10	ELECTROLYTIC
C 1524	4822 124 20678	47UF	-10+50	10	ELECTROLYTIC
C 1526	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1527	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1528	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1529	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1531	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1532	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1533	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1534	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1536	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1537	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1538	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1539	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1541	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1542	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1543	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1544	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1546	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1551	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1552	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1553	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1554	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1556	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1557	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1558	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1559	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1561	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1562	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1563	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1564	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1566	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1567	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1568	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1569	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1571	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1576	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1577	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1578	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1579	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1581	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1582	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1583	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1584	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1586	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1587	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1588	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1589	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1591	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1592	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1593	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1594	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1596	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE

ITEM	ORDERING NUMBER	FARAD	TOL (%)	VOLTS	REMARKS
C 1802	5322 124 74141	330UF	-10+30	400	ELECTROLYTIC
C 1803	5322 124 74141	330UF	-10+30	400	ELECTROLYTIC
C 1804	4822 121 40342	47NF	10	630	POLYESTER FOIL
C 1805	5322 121 44142	220NF	10	250	POLYESTER FOIL
C 1806	5322 122 54024	270PF	10	2000	CERAMIC DISK
C 1807	5322 121 44269	48,7 NF	5	500	POLYESTER FOIL
C 1808	5322 121 44269	48,7NF	5	500	POLYESTER FOIL
C 1809	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1810	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1811	4822 122 30128	4,7NF	10	100	CERAMIC PLATE
C 1812	5322 121 54049	3,3NF	1	63	POLYSTYRENE FOIL
C 1814	5322 124 24089	10UF	-20+20	16	ELECTROLYTIC
C 1816	5322 124 24089	10UF	-20+20	16	ELECTROLYTIC
C 1817	4822 121 41161	100NF	10	250	POLYESTER FOIL
C 1818	5322 124 24089	10UF	-20+20	16	ELECTROLYTIC
C 1819	5322 124 24187	33UF	-20+20	16	ELECTROLYTIC
C 1821	5322 124 24099	22UF	-20+20	25	ELECTROLYTIC
C 1863	5322 124 44025	4700UF	-10+50	10	ELECTROLYTIC
C 1864	5322 124 44025	4700UF	-10+50	10	ELECTROLYTIC
C 1866	4822 124 20768	1000UF	-10+50	10	ELECTROLYTIC
C 1867	4822 124 20694	330UF	-10+50	16	ELECTROLYTIC
C 1868	4822 124 20694	330UF	-10+50	16	ELECTROLYTIC
C 1869	4822 124 20694	330UF	-10+50	16	ELECTROLYTIC
C 1871	4822 122 31178	680PF	10	500	CERAMIC PLATE
C 1872	4822 121 40186	470NF	10	250	POLYESTER FOIL
C 1873	4822 121 40447	22UF		63	POLYESTER FOIL
C 1874	4822 121 40447	22UF		63	POLYESTER FOIL

ITEM	ORDERING NUMBER	OHM	TOL (%)	TYPE	REMARKS
RESISTORS					
R 1	4822 101 20441	10K	20	0.1W	CARBON POTM LIN
R 2	4822 101 20441	10K	20	0.1W	CARBON POTM LIN
R 3	5322 101 24172	470K	20	0.1W	CARBON POTM LIN
R 4	5322 101 44045	100K	20		CARBON POTM LIN + SWITCH
R 5	5322 101 24172	470K	20	0.1W	CARBON POTM LIN
R 6	5322 101 44046	10K	20		CARBON POTM LIN + SWITCH
R 101	5322 116 54506	287	1	MR25	METAL FILM
R 102	5322 116 64099	510	5	0.125W	METAL OXIDE
R 103	5322 116 54335	750K	1	MR30	METAL FILM
R 104	5322 111 30376	100M	5	0,125W	CARBON
R 106	5322 116 54735	255K	1	MR25	METAL FILM
R 107	5322 116 55454	1M	1	SPEC	METAL FILM
R 108	5322 116 54576	2,37K	1	MR25	METAL FILM
R 109	5322 116 64051	15	5	0.125W	METAL OXIDE
R 111	5322 116 50572	12,1K	1	MR25	METAL FILM
R 112	5322 116 64098	33	5	0.125W	METAL OXIDE
R 113	5322 116 50568	4,99	1	MR25	METAL FILM
R 114	4822 116 51234	750	1	MR25	METAL FILM
R 116	5322 116 54442	51,1	1	MR25	METAL FILM
R 117	5322 116 54743	301K	1	MR25	METAL FILM
R 118	5322 116 50568	4,99	1	MR25	METAL FILM
R 119	5322 116 54442	51,1	1	MR25	METAL FILM
R 121	5322 116 54706	127K	1	MR25	METAL FILM
R 122	5322 101 14048	47K	20	0,5W	TRIMMING POTM
R 123	5322 116 54442	51,1	1	MR25	METAL FILM
R 124	5322 116 54442	51,1	1	MR25	METAL FILM
R 126	5322 116 55357	82,5	1	MR25	METAL FILM
R 127	5322 116 55357	82,5	1	MR25	METAL FILM
R 128	5322 116 55357	82,5	1	MR25	METAL FILM
R 129	5322 116 55357	82,5	1	MR25	METAL FILM
R 130	5322 116 55357	82,5	1	MR25	METAL FILM
R 131	5322 116 55357	82,5	1	MR25	METAL FILM
R 132	4822 116 51235	1K	1	MR25	METAL FILM
R 133	4822 116 51235	1K	1	MR25	METAL FILM
R 134	4822 116 51235	1K	1	MR25	METAL FILM
R 136	5322 116 54442	51,1	1	MR25	METAL FILM
R 137	5322 116 54442	51,1	1	MR25	METAL FILM
R 138	5322 116 54442	51,1	1	MR25	METAL FILM
R 139	5322 116 55549	100	1	MR25	METAL FILM
R 141	5322 116 55549	100	1	MR25	METAL FILM
R 142	5322 116 55549	100	1	MR25	METAL FILM
R 143	5322 116 55549	100	1	MR25	METAL FILM
R 146	5322 116 55357	82,5	1	MR25	METAL FILM
R 147	5322 116 54442	51,1	1	MR25	METAL FILM
R 151	5322 116 54506	287	1	MR25	METAL FILM
R 152	5322 116 64099	510	5	0.125W	METAL OXIDE
R 153	5322 116 54335	750K	1	MR30	METAL FILM
R 154	5322 111 30376	100M	5	0,125W	CARBON
R 155	5322 116 54442	51,1	1	MR25	METAL FILM
R 156	5322 116 54735	255K	1	MR25	METAL FILM
R 157	5322 116 55454	1M	1	SPEC	METAL FILM
R 158	5322 116 54576	2,37K	1	MR25	METAL FILM
R 159	5322 116 64051	15	5	0.125W	METAL OXIDE
R 161	5322 116 50572	12,1K	1	MR25	METAL FILM
R 162	5322 116 64098	33	5	0.125W	METAL OXIDE
R 163	5322 116 50568	4,99	1	MR25	METAL FILM
R 164	4822 116 51234	750	1	MR25	METAL FILM
R 166	5322 116 54442	51,1	1	MR25	METAL FILM
R 167	5322 116 54743	301K	1	MR25	METAL FILM
R 168	5322 116 50568	4.99	1	MR25	METAL FILM
R 169	5322 116 54442	51,1	1	MR25	METAL FILM
R 171	5322 116 54706	127K	1	MR25	METAL FILM
R 172	5322 101 14048	47K	20	0.5W	TRIMMING POTM
R 173	5322 116 54442	51,1	1	MR25	METAL FILM
R 174	5322 116 54442	51,1	1	MR25	METAL FILM
R 176	5322 116 55357	82,5	1	MR25	METAL FILM
R 177	5322 116 55357	82,5	1	MR25	METAL FILM
R 178	5322 116 55357	82,5	1	MR25	METAL FILM

ITEM	ORDERING NUMBER	OHM	TOL (%)	TYPE	REMARKS
R 179	5322 116 55357	82,5	1	MR25	METAL FILM
R 181	5322 116 55357	82,5	1	MR25	METAL FILM
R 182	4822 116 51235	1K	1	MR25	METAL FILM
R 183	4822 116 51235	1K	1	MR25	METAL FILM
R 184	4822 116 51235	1K	1	MR25	METAL FILM
R 186	5322 116 54442	51,1	1	MR25	METAL FILM
R 187	5322 116 54442	51,1	1	MR25	METAL FILM
R 188	5322 116 54442	51,1	1	MR25	METAL FILM
R 189	5322 116 55549	100	1	MR25	METAL FILM
R 191	5322 116 55549	100	1	MR25	METAL FILM
R 192	5322 116 55549	100	1	MR25	METAL FILM
R 193	5322 116 55549	100	1	MR25	METAL FILM
R 201	5322 116 54506	287	1	MR25	METAL FILM
R 202	5322 116 64099	510	5	0.125W	METAL OXIDE
R 203	5322 116 54335	750K	1	MR30	METAL FILM
R 204	5322 111 30376	100M	5	0,125W	CARBON
R 206	5322 116 54735	255K	1	MR25	METAL FILM
R 207	5322 116 55454	1M	1	SPEC	METAL FILM
R 208	5322 116 54576	2,37K	1	MR25	METAL FILM
R 209	5322 116 64051	15	5	0.125W	METAL OXIDE
R 211	5322 116 50572	12,1K	1	MR25	METAL FILM
R 212	5322 116 64098	33	5	0.125W	METAL OXIDE
R 213	5322 116 50568	4,99	1	MR25	METAL FILM
R 214	4822 116 51234	750	1	MR25	METAL FILM
R 216	5322 116 54442	51,1	1	MR25	METAL FILM
R 217	5322 116 54743	301K	1	MR25	METAL FILM
R 218	5322 116 50568	4,99	1	MR25	METAL FILM
R 219	5322 116 54442	51,1	1	MR25	METAL FILM
R 221	5322 116 54706	127K	1	MR25	METAL FILM
R 222	5322 101 14048	47K	20	0,5W	TRIMMING POTM
R 223	5322 116 54442	51,1	1	MR25	METAL FILM
R 224	5322 116 54442	51,1	1	MR25	METAL FILM
R 226	5322 116 55357	82,5	1	MR25	METAL FILM
R 227	5322 116 55357	82,5	1	MR25	METAL FILM
R 228	5322 116 55357	82,5	1	MR25	METAL FILM
R 229	5322 116 55357	82,5	1	MR25	METAL FILM
R 231	5322 116 55357	82,5	1	MR25	METAL FILM
R 232	4822 116 51235	1K	1	MR25	METAL FILM
R 233	4822 116 51235	1K	1	MR25	METAL FILM
R 234	4822 116 51235	1K	1	MR25	METAL FILM
R 236	5322 116 54442	51,1	1	MR25	METAL FILM
R 237	5322 116 54442	51,1	1	MR25	METAL FILM
R 238	5322 116 54442	51,1	1	MR25	METAL FILM
R 239	5322 116 55549	100	1	MR25	METAL FILM
R 241	5322 116 55549	100	1	MR25	METAL FILM
R 242	5322 116 55549	100	1	MR25	METAL FILM
R 243	5322 116 55549	100	1	MR25	METAL FILM
R 251	5322 116 54506	287	1	MR25	METAL FILM
R 252	5322 116 64099	510	5	0.125W	METAL OXIDE
R 253	5322 116 54335	750K	1	MR30	METAL FILM
R 254	5322 111 30376	100M	5	0,125W	CARBON
R 256	5322 116 54735	255K	1	MR25	METAL FILM
R 257	5322 116 55454	1M	1	SPEC	METAL FILM
R 258	5322 116 54576	2,37K	1	MR25	METAL FILM
R 259	5322 116 64051	15	5	0.125W	METAL OXIDE
R 261	5322 116 50572	12,1K	1	MR25	METAL FILM
R 262	5322 116 64098	33	5	0.125W	METAL OXIDE
R 263	5322 116 50568	4,99	1	MR25	METAL FILM
R 264	4822 116 51234	750	1	MR25	METAL FILM
R 266	5322 116 54442	51,1	1	MR25	METAL FILM
R 267	5322 116 54743	301K	1	MR25	METAL FILM
R 268	5322 116 50568	4,99	1	MR25	METAL FILM
R 269	5322 116 54442	51,1	1	MR25	METAL FILM
R 271	5322 116 54706	127K	1	MR25	METAL FILM
R 272	5322 101 14048	47K	20	0,5W	TRIMMING POTM
R 273	5322 116 54442	51,1	1	MR25	METAL FILM
R 274	5322 116 54442	51,1	1	MR25	METAL FILM
R 276	5322 116 55357	82,5	1	MR25	METAL FILM
R 277	5322 116 55357	82,5	1	MR25	METAL FILM
R 278	5322 116 55357	82,5	1	MR25	METAL FILM

ITEM	ORDERING NUMBER	OHM	TOL (%)	TYPE	REMARKS
R 279	5322 116 55357	82,5	1	MR25	METAL FILM
R 280	5322 116 55357	82,5	1	MR25	METAL FILM
R 281	5322 116 55357	82,5	1	MR25	METAL FILM
R 282	4822 116 51235	1K	1	MR25	METAL FILM
R 283	4822 116 51235	1K	1	MR25	METAL FILM
R 284	4822 116 51235	1K	1	MR25	METAL FILM
R 286	5322 116 54442	51,1	1	MR25	METAL FILM
R 287	5322 116 54442	51,1	1	MR25	METAL FILM
R 288	5322 116 54442	51,1	1	MR25	METAL FILM
R 289	5322 116 55549	100	1	MR25	METAL FILM
R 291	5322 116 55549	100	1	MR25	METAL FILM
R 292	5322 116 55549	100	1	MR25	METAL FILM
R 293	5322 116 55549	100	1	MR25	METAL FILM
R 301	5322 116 54506	287	1	MR25	METAL FILM
R 302	5322 116 64099	510	5	0.125W	METAL OXIDE
R 303	5322 116 54335	750K	1	MR30	METAL FILM
R 304	5322 111 30376	100M	5	0,125W	CARBON
R 306	5322 116 54735	255K	1	MR25	METAL FILM
R 307	5322 116 55454	1M	1	SPEC	METAL FILM
R 308	5322 116 54576	2,37K	1	MR25	METAL FILM
R 309	5322 116 64051	15	5	0.125W	METAL OXIDE
R 311	5322 116 50572	12,1K	1	MR25	METAL FILM
R 312	5322 116 64098	33	5	0.125W	METAL OXIDE
R 313	5322 116 50568	4,99	1	MR25	METAL FILM
R 314	4822 116 51234	750	1	MR25	METAL FILM
R 316	5322 116 54442	51,1	1	MR25	METAL FILM
R 317	5322 116 54743	301K	1	MR25	METAL FILM
R 318	5322 116 50568	4,99	1	MR25	METAL FILM
R 319	5322 116 54442	51,1	1	MR25	METAL FILM
R 321	5322 116 54706	127K	1	MR25	METAL FILM
R 322	5322 101 14048	47K	20	0,5W	TRIMMING POTM
R 323	5322 116 54442	51,1	1	MR25	METAL FILM
R 324	5322 116 54442	51,1	1	MR25	METAL FILM
R 326	5322 116 55357	82,5	1	MR25	METAL FILM
R 327	5322 116 55357	82,5	1	MR25	METAL FILM
R 328	5322 116 55357	82,5	1	MR25	METAL FILM
R 329	5322 116 55357	82,5	1	MR25	METAL FILM
R 330	5322 116 55357	82,5	1	MR25	METAL FILM
R 331	5322 116 55357	82,5	1	MR25	METAL FILM
R 332	4822 116 51235	1K	1	MR25	METAL FILM
R 333	4822 116 51235	1K	1	MR25	METAL FILM
R 334	4822 116 51235	1K	1	MR25	METAL FILM
R 336	5322 116 54442	51,1	1	MR25	METAL FILM
R 337	5322 116 54442	51,1	1	MR25	METAL FILM
R 338	5322 116 54442	51,1	1	MR25	METAL FILM
R 339	5322 116 55549	100	1	MR25	METAL FILM
R 341	5322 116 55549	100	1	MR25	METAL FILM
R 342	5322 116 55549	100	1	MR25	METAL FILM
R 343	5322 116 55549	100	1	MR25	METAL FILM
R 346	5322 116 55357	82,5	1	MR25	METAL FILM
R 347	5322 116 54442	51,1	1	MR25	METAL FILM
R 351	5322 116 54506	287	1	MR25	METAL FILM
R 352	5322 116 64099	510	5	0.125W	METAL OXIDE
R 353	5322 116 54335	750K	1	MR30	METAL FILM
R 354	5322 111 30376	100M	5	0,125W	CARBON
R 355	5322 116 54442	51,1	1	MR25	METAL FILM
R 356	5322 116 54735	255K	1	MR25	METAL FILM
R 357	5322 116 55454	1M	1	SPEC	METAL FILM
R 358	5322 116 54576	2,37K	1	MR25	METAL FILM
R 359	5322 116 64051	15	5	0.125W	METAL OXIDE
R 361	5322 116 50572	12,1K	1	MR25	METAL FILM
R 362	5322 116 64098	33	5	0.125W	METAL OXIDE
R 363	5322 116 50568	4,99	1	MR25	METAL FILM
R 364	4822 116 51234	750	1	MR25	METAL FILM
R 366	5322 116 54442	51,1	1	MR25	METAL FILM
R 367	5322 116 54743	301K	1	MR25	METAL FILM
R 368	5322 116 50568	4,99	1	MR25	METAL FILM
R 369	5322 116 54442	51,1	1	MR25	METAL FILM
R 371	5322 116 54706	127K	1	MR25	METAL FILM
R 372	5322 101 14048	47K	20	0,5W	TRIMMING POTM

ITEM	ORDERING NUMBER	OHM	TOL (%)	TYPE	REMARKS
R 373	5322 116 54442	51,1	1	MR25	METAL FILM
R 374	5322 116 54442	51,1	1	MR25	METAL FILM
R 376	5322 116 55357	82,5	1	MR25	METAL FILM
R 377	5322 116 55357	82,5	1	MR25	METAL FILM
R 378	5322 116 55357	82,5	1	MR25	METAL FILM
R 379	5322 116 55357	82,5	1	MR25	METAL FILM
R 381	5322 116 55357	82,5	1	MR25	METAL FILM
R 382	4822 116 51235	1K	1	MR25	METAL FILM
R 383	4822 116 51235	1K	1	MR25	METAL FILM
R 384	4822 116 51235	1K	1	MR25	METAL FILM
R 386	5322 116 54442	51,1	1	MR25	METAL FILM
R 387	5322 116 54442	51,1	1	MR25	METAL FILM
R 388	5322 116 54442	51,1	1	MR25	METAL FILM
R 389	5322 116 55549	100	1	MR25	METAL FILM
R 391	5322 116 55549	100	1	MR25	METAL FILM
R 392	5322 116 55549	100	1	MR25	METAL FILM
R 393	5322 116 55549	100	1	MR25	METAL FILM
R 401	5322 116 54506	287	1	MR25	METAL FILM
R 402	5322 116 64099	510	5	0.125W	METAL OXIDE
R 403	5322 116 54335	750K	1	MR30	METAL FILM
R 404	5322 111 30376	100M	5	0,125W	CARBON
R 406	5322 116 54735	255K	1	MR25	METAL FILM
R 407	5322 116 55454	1M	1	SPEC	METAL FILM
R 408	5322 116 54576	2,37K	1	MR25	METAL FILM
R 409	5322 116 64051	15	5	0.125W	METAL OXIDE
R 411	5322 116 50572	12,1K	1	MR25	METAL FILM
R 412	5322 116 64098	33	5	0.125W	METAL OXIDE
R 413	5322 116 50568	4,99	1	MR25	METAL FILM
R 414	4822 116 51234	750	1	MR25	METAL FILM
R 416	5322 116 54442	51.1	1	MR25	METAL FILM
R 417	5322 116 54743	301K	1	MR25	METAL FILM
R 418	5322 116 50568	4,99	1	MR25	METAL FILM
R 419	5322 116 54442	51,1	1	MR25	METAL FILM
R 421	5322 116 54706	127K	1	MR25	METAL FILM
R 422	5322 101 14048	47K	20	0,5W	TRIMMING POTM
R 423	5322 116 54442	51,1	1	MR25	METAL FILM
R 424	5322 116 54442	51,1	1	MR25	METAL FILM
R 426	5322 116 55357	82,5	1	MR25	METAL FILM
R 427	5322 116 55357	82,5	1	MR25	METAL FILM
R 428	5322 116 55357	82,5	1	MR25	METAL FILM
R 429	5322 116 55357	82,5	1	MR25	METAL FILM
R 431	5322 116 55357	82,5	1	MR25	METAL FILM
R 432	4822 116 51235	1K	1	MR25	METAL FILM
R 433	4822 116 51235	1K	1	MR25	METAL FILM
R 434	4822 116 51235	1K	1	MR25	METAL FILM
R 436	5322 116 54442	51,1	1	MR25	METAL FILM
R 437	5322 116 54442	51,1	1	MR25	METAL FILM
R 438	5322 116 54442	51,1	1	MR25	METAL FILM
R 439	5322 116 55549	100	1	MR25	METAL FILM
R 441	5322 116 55549	100	1	MR25	METAL FILM
R 442	5322 116 55549	100	1	MR25	METAL FILM
R 443	5322 116 55549	100	1	MR25	METAL FILM
R 451	5322 116 54506	287	1	MR25	METAL FILM
R 452	5322 116 64099	510	5	0.125W	METAL OXIDE
R 453	5322 116 54335	750K	1	MR30	METAL FILM
R 454	5322 111 30376	100M	5	0,125W	CARBON
R 456	5322 116 54735	255K	1	MR25	METAL FILM
R 457	5322 116 55454	1M	1	SPEC	METAL FILM
R 458	5322 116 54576	2,37K	1	MR25	METAL FILM
R 459	5322 116 64051	15	5	0.125W	METAL OXIDE
R 461	5322 116 50572	12,1K	1	MR25	METAL FILM
R 462	5322 116 64098	33	5	0.125W	METAL OXIDE
R 463	5322 116 50568	4,99	1	MR25	METAL FILM
R 464	4822 116 51234	750	1	MR25	METAL FILM
R 466	5322 116 54442	51,1	1	MR25	METAL FILM
R 467	5322 116 54743	301K	1	MR25	METAL FILM
R 468	5322 116 50568	4,99	1	MR25	METAL FILM
R 469	5322 116 54442	51,1	1	MR25	METAL FILM
R 471	5322 116 54706	127K	1	MR25	METAL FILM
R 472	5322 101 14048	47K	20	0,5W	TRIMMING POTM

ITEM	ORDERING NUMBER	OHM	TOL (%)	TYPE	REMARKS
R 473	5322 116 54442	51,1	1	MR25	METAL FILM
R 474	5322 116 54442	51,1	1	MR25	METAL FILM
R 476	5322 116 55357	82,5	1	MR25	METAL FILM
R 477	5322 116 55357	82,5	1	MR25	METAL FILM
R 478	5322 116 55357	82,5	1	MR25	METAL FILM
R 479	5322 116 55357	82,5	1	MR25	METAL FILM
R 480	5322 116 55357	82,5	1	MR25	METAL FILM
R 481	5322 116 55357	82,5	1	MR25	METAL FILM
R 482	4822 116 51235	1K	1	MR25	METAL FILM
R 483	4822 116 51235	1K	1	MR25	METAL FILM
R 484	4822 116 51235	1K	1	MR25	METAL FILM
R 486	5322 116 54442	51,1	1	MR25	METAL FILM
R 487	5322 116 54442	51,1	1	MR25	METAL FILM
R 488	5322 116 54442	51,1	1	MR25	METAL FILM
R 489	5322 116 55549	100	1	MR25	METAL FILM
R 491	5322 116 55549	100	1	MR25	METAL FILM
R 492	5322 116 55549	100	1	MR25	METAL FILM
R 493	5322 116 55549	100	1	MR25	METAL FILM
R 501	5322 116 54506	287	1	MR25	METAL FILM
R 502	5322 116 64099	510	5	0.125W	METAL OXIDE
R 503	5322 116 54335	750K	1	MR30	METAL FILM
R 504	5322 111 30376	100M	5	0,12⁵W	CARBON
R 506	5322 116 54735	255K	1	MR25	METAL FILM
R 507	5322 116 55454	1M	1	SPEC	METAL FILM
R 508	5322 116 54576	2,37K	1	MR25	METAL FILM
R 509	5322 116 64051	15	5	0.125W	METAL OXIDE
R 511	5322 116 50572	12,1K	1	MR25	METAL FILM
R 512	5322 116 64098	33	5	0.125W	METAL OXIDE
R 513	5322 116 50568	4,99	1	MR25	METAL FILM
R 514	4822 116 51234	750	1	MR25	METAL FILM
R 516	5322 116 54442	51,1	1	MR25	METAL FILM
R 517	5322 116 54743	301K	1	MR25	METAL FILM
R 518	5322 116 50568	4,99	1	MR25	METAL FILM
R 519	5322 116 54442	51,1	1	MR25	METAL FILM
R 521	5322 116 54706	127K	1	MR25	METAL FILM
R 522	5322 101 14048	47K	20	0,5W	TRIMMING POTM
R 523	5322 116 54442	51,1	1	MR25	METAL FILM
R 524	5322 116 54442	51,1	1	MR25	METAL FILM
R 526	5322 116 55357	82,5	1	MR25	METAL FILM
R 527	5322 116 55357	82,5	1	MR25	METAL FILM
R 528	5322 116 55357	82,5	1	MR25	METAL FILM
R 529	5322 116 55357	82,5	1	MR25	METAL FILM
R 530	5322 116 55357	82,5	1	MR25	METAL FILM
R 531	5322 116 55357	82,5	1	MR25	METAL FILM
R 532	4822 116 51235	1K	1	MR25	METAL FILM
R 533	4822 116 51235	1K	1	MR25	METAL FILM
R 534	4822 116 51235	1K	1	MR25	METAL FILM
R 536	5322 116 54442	51,1	1	MR25	METAL FILM
R 537	5322 116 54442	51,1	1	MR25	METAL FILM
R 538	5322 116 54442	51,1	1	MR25	METAL FILM
R 539	5322 116 55549	100	1	MR25	METAL FILM
R 541	5322 116 55549	100	1	MR25	METAL FILM
R 542	5322 116 55549	100	1	MR25	METAL FILM
R 543	5322 116 55549	100	1	MR25	METAL FILM
R 546	5322 116 55357	82,5	1	MR25	METAL FILM
R 547	5322 116 54442	51,1	1	MR25	METAL FILM
R 551	5322 116 54506	287	1	MR25	METAL FILM
R 552	5322 116 64099	510	5	0.125W	METAL OXIDE
R 553	5322 116 54335	750K	1	MR30	METAL FILM
R 554	5322 111 30376	100M	5	0,125W	CARBON
R 555	5322 116 54442	51,1	1	MR25	METAL FILM
R 556	5322 116 54735	255K	1	MR25	METAL FILM
R 557	5322 116 55454	1M	1	SPEC	METAL FILM
R 558	5322 116 54576	2,37K	1	MR25	METAL FILM
R 559	5322 116 64051	15	5	0.125W	METAL OXIDE
R 561	5322 116 50572	12,1K	1	MR25	METAL FILM
R 562	5322 116 64098	33	5	0.125W	METAL OXIDE
R 563	5322 116 50568	4,99	1	MR25	METAL FILM
R 564	4822 116 51234	750	1	MR25	METAL FILM
R 566	5322 116 54442	51,1	1	MR25	METAL FILM

ITEM	ORDERING NUMBER	OHM	TOL (%)	TYPE	REMARKS
R 567	5322 116 54743	301K	1	MR25	METAL FILM
R 568	5322 116 50568	4,99	1	MR25	METAL FILM
R 569	5322 116 54442	51,1	1	MR25	METAL FILM
R 571	5322 116 54706	127K	1	MR25	METAL FILM
R 572	5322 101 14048	47K	20	0,5W	TRIMMING POTM
R 573	5322 116 54442	51,1	1	MR25	METAL FILM
R 574	5322 116 54442	51,1	1	MR25	METAL FILM
R 576	5322 116 55357	82,5	1	MR25	METAL FILM
R 577	5322 116 55357	82,5	1	MR25	METAL FILM
R 578	5322 116 55357	82,5	1	MR25	METAL FILM
R 579	5322 116 55357	82,5	1	MR25	METAL FILM
R 581	5322 116 55357	82,5	1	MR25	METAL FILM
R 582	4822 116 51235	1K	1	MR25	METAL FILM
R 583	4822 116 51235	1K	1	MR25	METAL FILM
R 584	4822 116 51235	1K	1	MR25	METAL FILM
R 586	5322 116 54442	51,1	1	MR25	METAL FILM
R 587	5322 116 54442	51,1	1	MR25	METAL FILM
R 588	5322 116 54442	51,1	1	MR25	METAL FILM
R 589	5322 116 55549	100	1	MR25	METAL FILM
R 591	5322 116 55549	100	1	MR25	METAL FILM
R 592	5322 116 55549	100	1	MR25	METAL FILM
R 593	5322 116 55549	100	1	MR25	METAL FILM
R 601	5322 116 54506	287	1	MR25	METAL FILM
R 602	5322 116 64099	510	5	0.125W	METAL OXIDE
R 603	5322 116 54335	750K	1	MR30	METAL FILM
R 604	5322 111 30376	100M	5	0,125W	CARBON
R 606	5322 116 54735	255K	1	MR25	METAL FILM
R 607	5322 116 55454	1M	1	SPEC	METAL FILM
R 608	5322 116 54576	2,37K	1	MR25	METAL FILM
R 609	5322 116 64051	15	5	0.125W	METAL OXIDE
R 611	5322 116 50572	12,1K	1	MR25	METAL FILM
R 612	5322 116 64098	33	5	0.125W	METAL OXIDE
R 613	5322 116 50568	4,99	1	MR25	METAL FILM
R 614	4822 116 51234	750	1	MR25	METAL FILM
R 616	5322 116 54442	51,1	1	MR25	METAL FILM
R 617	5322 116 54743	301K	1	MR25	METAL FILM
R 618	5322 116 50568	4,99	1	MR25	METAL FILM
R 619	5322 116 54442	51,1	1	MR25	METAL FILM
R 621	5322 116 54706	127K	1	MR25	METAL FILM
R 622	5322 101 14048	47K	20	0,5W	TRIMMING POTM
R 623	5322 116 54442	51,1	1	MR25	METAL FILM
R 624	5322 116 54442	51,1	1	MR25	METAL FILM
R 626	5322 116 55357	82,5	1	MR25	METAL FILM
R 627	5322 116 55357	82,5	1	MR25	METAL FILM
R 628	5322 116 55357	82,5	1	MR25	METAL FILM
R 629	5322 116 55357	82,5	1	MR25	METAL FILM
R 631	5322 116 55357	82,5	1	MR25	METAL FILM
R 632	4822 116 51235	1K	1	MR25	METAL FILM
R 633	4822 116 51235	1K	1	MR25	METAL FILM
R 634	4822 116 51235	1K	1	MR25	METAL FILM
R 636	5322 116 54442	51,1	1	MR25	METAL FILM
R 637	5322 116 54442	51,1	1	MR25	METAL FILM
R 638	5322 116 54442	51,1	1	MR25	METAL FILM
R 639	5322 116 55549	100	1	MR25	METAL FILM
R 641	5322 116 55549	100	1	MR25	METAL FILM
R 642	5322 116 55549	100	1	MR25	METAL FILM
R 643	5322 116 55549	100	1	MR25	METAL FILM
R 651	5322 116 54506	287	1	MR25	METAL FILM
R 652	5322 116 64099	510	5	0.125W	METAL OXIDE
R 653	5322 116 54335	750K	1	MR30	METAL FILM
R 654	5322 111 30376	100M	5	0,125W	CARBON
R 656	5322 116 54735	255K	1	MR25	METAL FILM
R 657	5322 116 55454	1M	1	SPEC	METAL FILM
R 658	5322 116 54576	2,37K	1	MR25	METAL FILM
R 659	5322 116 64051	15	5	0.125W	METAL OXIDE
R 661	5322 116 50572	12,1K	1	MR25	METAL FILM
R 662	5322 116 64098	33	5	0.125W	METAL OXIDE
R 663	5322 116 50568	4,99	1	MR25	METAL FILM
R 664	4822 116 51234	750	1	MR25	METAL FILM
R 666	5322 116 54442	51,1	1	MR25	METAL FILM

ITEM	ORDERING NUMBER	OHM	TOL (%)	TYPE	REMARKS
R 667	5322 116 54743	301K	1	MR25	METAL FILM
R 668	5322 116 50568	4,99	1	MR25	METAL FILM
R 669	5322 116 54442	51,1	1	MR25	METAL FILM
R 671	5322 116 54706	127K	1	MR25	METAL FILM
R 672	5322 101 14048	47K	20	0,5W	TRIMMING POTM
R 673	5322 116 54442	51,1	1	MR25	METAL FILM
R 674	5322 116 54442	51,1	1	MR25	METAL FILM
R 676	5322 116 55357	82,5	1	MR25	METAL FILM
R 677	5322 116 55357	82,5	1	MR25	METAL FILM
R 678	5322 116 55357	82,5	1	MR25	METAL FILM
R 679	5322 116 55357	82,5	1	MR25	METAL FILM
R 680	5322 116 55357	82,5	1	MR25	METAL FILM
R 681	5322 116 55357	82,5	1	MR25	METAL FILM
R 682	4822 116 51235	1K	1	MR25	METAL FILM
R 683	4822 116 51235	1K	1	MR25	METAL FILM
R 684	4822 116 51235	1K	1	MR25	METAL FILM
R 686	5322 116 54442	51,1	1	MR25	METAL FILM
R 687	5322 116 54442	51,1	1	MR25	METAL FILM
R 688	5322 116 54442	51,1	1	MR25	METAL FILM
R 689	5322 116 55549	100	1	MR25	METAL FILM
R 691	5322 116 55549	100	1	MR25	METAL FILM
R 692	5322 116 55549	100	1	MR25	METAL FILM
R 693	5322 116 55549	100	1	MR25	METAL FILM
R 701	5322 116 54506	287	1	MR25	METAL FILM
R 702	5322 116 64099	510	5	0.125W	METAL OXIDE
R 703	5322 116 54335	750K	1	MR30	METAL FILM
R 704	5322 111 30376	100M	5	0,125W	CARBON
R 706	5322 116 54735	255K	1	MR25	METAL FILM
R 707	5322 116 55454	1M	1	SPEC	METAL FILM
R 708	5322 116 54576	2,37K	1	MR25	METAL FILM
R 709	5322 116 64051	15	5	0.125W	METAL OXIDE
R 711	5322 116 50572	12,1K	1	MR25	METAL FILM
R 712	5322 116 64098	33	5	0.125W	METAL OXIDE
R 713	5322 116 50568	4,99	1	MR25	METAL FILM
R 714	4822 116 51234	750	1	MR25	METAL FILM
R 716	5322 116 54442	51,1	1	MR25	METAL FILM
R 717	5322 116 54743	301K	1	MR25	METAL FILM
R 718	5322 116 50568	4,99	1	MR25	METAL FILM
R 719	5322 116 54442	51,1	1	MR25	METAL FILM
R 721	5322 116 54706	127K	1	MR25	METAL FILM
R 722	5322 101 14048	47K	20	0,5W	TRIMMING POTM
R 723	5322 116 54442	51,1	1	MR25	METAL FILM
R 724	5322 116 54442	51,1	1	MR25	METAL FILM
R 726	5322 116 55357	82,5	1	MR25	METAL FILM
R 727	5322 116 55357	82,5	1	MR25	METAL FILM
R 728	5322 116 55357	82,5	1	MR25	METAL FILM
R 729	5322 116 55357	82,5	1	MR25	METAL FILM
R 730	5322 116 55357	82,5	1	MR25	METAL FILM
R 731	5322 116 55357	82,5	1	MR25	METAL FILM
R 732	4822 116 51235	1K	1	MR25	METAL FILM
R 733	4822 116 51235	1K	1	MR25	METAL FILM
R 734	4822 116 51235	1K	1	MR25	METAL FILM
R 736	5322 116 54442	51,1	1	MR25	METAL FILM
R 737	5322 116 54442	51,1	1	MR25	METAL FILM
R 738	5322 116 54442	51,1	1	MR25	METAL FILM
R 739	5322 116 55549	100	1	MR25	METAL FILM
R 741	5322 116 55549	100	1	MR25	METAL FILM
R 742	5322 116 55549	100	1	MR25	METAL FILM
R 743	5322 116 55549	100	1	MR25	METAL FILM
R 746	5322 116 55357	82,5	1	MR25	METAL FILM
R 747	5322 116 54442	51,1	1	MR25	METAL FILM
R 751	5322 116 54506	287	1	MR25	METAL FILM
R 752	5322 116 64099	510	5	0.125W	METAL OXIDE
R 753	5322 116 54335	750K	1	MR30	METAL FILM
R 754	5322 111 30376	100M	5	0,125W	CARBON
R 755	5322 116 54442	51,1	1	MR25	METAL FILM
R 756	5322 116 54735	255K	1	MR25	METAL FILM
R 757	5322 116 55454	1M	1	SPEC	METAL FILM
R 758	5322 116 54576	2,37K	1	MR25	METAL FILM
R 759	5322 116 64051	15	5	0.125W	METAL OXIDE

ITEM	ORDERING NUMBER	OHM	TOL (%)	TYPE	REMARKS
R 761	5322 116 50572	12,1K	1	MR25	METAL FILM
R 762	5322 116 64098	33	5	0.125W	METAL OXIDE
R 763	5322 116 50568	4,99	1	MR25	METAL FILM
R 764	4822 116 51234	750	1	MR25	METAL FILM
R 766	5322 116 54442	51,1	1	MR25	METAL FILM
R 767	5322 116 54743	301K	1	MR25	METAL FILM
R 768	5322 116 50568	4,99	1	MR25	METAL FILM
R 769	5322 116 54442	51,1	1	MR25	METAL FILM
R 771	5322 116 54706	127K	1	MR25	METAL FILM
R 772	5322 101 14048	47K	20	0,5W	TRIMMING POTM
R 773	5322 116 54442	51,1	1	MR25	METAL FILM
R 774	5322 116 54442	51,1	1	MR25	METAL FILM
R 776	5322 116 55357	82,5	1	MR25	METAL FILM
R 777	5322 116 55357	82,5	1	MR25	METAL FILM
R 778	5322 116 55357	82,5	1	MR25	METAL FILM
R 779	5322 116 55357	82,5	1	MR25	METAL FILM
R 781	5322 116 55357	82,5	1	MR25	METAL FILM
R 782	4822 116 51235	1K	1	MR25	METAL FILM
R 783	4822 116 51235	1K	1	MR25	METAL FILM
R 784	4822 116 51235	1K	1	MR25	METAL FILM
R 786	5322 116 54442	51,1	1	MR25	METAL FILM
R 787	5322 116 54442	51,1	1	MR25	METAL FILM
R 788	5322 116 54442	51,1	1	MR25	METAL FILM
R 789	5322 116 55549	100	1	MR25	METAL FILM
R 791	5322 116 55549	100	1	MR25	METAL FILM
R 792	5322 116 55549	100	1	MR25	METAL FILM
R 793	5322 116 55549	100	1	MR25	METAL FILM
R 801	5322 116 54506	287	1	MR25	METAL FILM
R 802	5322 116 64099	510	5	0.125W	METAL OXIDE
R 803	5322 116 54335	750K	1	MR30	METAL FILM
R 804	5322 111 30376	100M	5	0,125W	CARBON
R 806	5322 116 54735	255K	1	MR25	METAL FILM
R 807	5322 116 55454	1M	1	SPEC	METAL FILM
R 808	5322 116 54576	2,37K	1	MR25	METAL FILM
R 809	5322 116 64051	15	5	0.125W	METAL OXIDE
R 811	4822 110 70039	3	5	CR25	CARBON PIN-HEAD
R 812	5322 116 64098	33	5	0.125W	METAL OXIDE
R 813	5322 116 50568	4,99	1	MR25	METAL FILM
R 814	4822 116 51234	750	1	MR25	METAL FILM
R 816	5322 116 54442	51,1	1	MR25	METAL FILM
R 817	5322 116 54743	301K	1	MR25	METAL FILM
R 818	5322 116 50568	4,99	1	MR25	METAL FILM
R 819	5322 116 54442	51,1	1	MR25	METAL FILM
R 821	5322 116 54706	127K	1	MR25	METAL FILM
R 822	5322 101 14048	47K	20	0,5W	TRIMMING POTM
R 823	5322 116 54442	51,1	1	MR25	METAL FILM
R 824	5322 116 54442	51,1	1	MR25	METAL FILM
R 826	5322 116 55357	82,5	1	MR25	METAL FILM
R 827	5322 116 55357	82,5	1	MR25	METAL FILM
R 828	5322 116 55357	82,5	1	MR25	METAL FILM
R 829	5322 116 55357	82,5	1	MR25	METAL FILM
R 831	5322 116 55357	82,5	1	MR25	METAL FILM
R 832	4822 116 51235	1K	1	MR25	METAL FILM
R 833	4822 116 51235	1K	1	MR25	METAL FILM
R 834	4822 116 51235	1K	1	MR25	METAL FILM
R 836	5322 116 54442	51,1	1	MR25	METAL FILM
R 837	5322 116 54442	51,1	1	MR25	METAL FILM
R 838	5322 116 54442	51,1	1	MR25	METAL FILM
R 839	5322 116 55549	100	1	MR25	METAL FILM
R 841	5322 116 55549	100	1	MR25	METAL FILM
R 842	5322 116 55549	100	1	MR25	METAL FILM
R 843	5322 116 55549	100	1	MR25	METAL FILM
R 851	5322 116 54506	287	1	MR25	METAL FILM
R 852	5322 116 64099	510	5	0.125W	METAL OXIDE
R 853	5322 116 54335	750K	1	MR30	METAL FILM
R 854	5322 111 30376	100M	5	0,125W	CARBON
R 856	5322 116 54735	255K	1	MR25	METAL FILM
R 857	5322 116 55454	1M	1	SPEC	METAL FILM
R 858	5322 116 54576	2,37K	1	MR25	METAL FILM
R 859	5322 116 64051	15	5	0.125W	METAL OXIDE

ITEM	ORDERING NUMBER	OHM	TOL (%)	TYPE	REMARKS
R 861	5322 116 50572	12,1K	1	MR25	METAL FILM
R 862	5322 116 64098	33	5	0.125W	METAL OXIDE
R 863	5322 116 50568	4,99	1	MR25	METAL FILM
R 864	4822 116 51234	750	1	MR25	METAL FILM
R 866	5322 116 54442	51,1	1	MR25	METAL FILM
R 867	5322 116 54743	301K	1	MR25	METAL FILM
R 868	5322 116 50568	4,99	1	MR25	METAL FILM
R 869	5322 116 54442	51,1	1	MR25	METAL FILM
R 871	5322 116 54706	127K	1	MR25	METAL FILM
R 872	5322 101 14048	47K	20	0,5W	TRIMMING POTM
R 873	5322 116 54442	51,1	1	MR25	METAL FILM
R 874	5322 116 54442	51,1	1	MR25	METAL FILM
R 876	5322 116 55357	82,5	1	MR25	METAL FILM
R 877	5322 116 55357	82,5	1	MR25	METAL FILM
R 878	5322 116 55357	82,5	1	MR25	METAL FILM
R 879	5322 116 55357	82,5	1	MR25	METAL FILM
R 880	5322 116 55357	82,5	1	MR25	METAL FILM
R 881	5322 116 55357	82,5	1	MR25	METAL FILM
R 882	4822 116 51235	1K	1	MR25	METAL FILM
R 883	4822 116 51235	1K	1	MR25	METAL FILM
R 884	4822 116 51235	1K	1	MR25	METAL FILM
R 886	5322 116 54442	51,1	1	MR25	METAL FILM
R 887	5322 116 54442	51,1	1	MR25	METAL FILM
R 888	5322 116 54442	51,1	1	MR25	METAL FILM
R 889	5322 116 55549	100	1	MR25	METAL FILM
R 891	5322 116 55549	100	1	MR25	METAL FILM
R 892	5322 116 55549	100	1	MR25	METAL FILM
R 893	5322 116 55549	100	1	MR25	METAL FILM
R 900	5322 116 54504	274	1	MR25	METAL FILM
R 901	5322 116 54506	287	1	MR25	METAL FILM
R 902	5322 116 64099	510	5	0.125W	METAL OXIDE
R 903	5322 116 54335	750K	1	MR30	METAL FILM
R 904	5322 111 30376	100M	5	0,125W	CARBON
R 906	5322 116 54735	255K	1	MR25	METAL FILM
R 907	5322 116 55454	1M	1	SPEC	METAL FILM
R 908	5322 116 54576	2,37K	1	MR25	METAL FILM
R 909	5322 116 50568	4,99	1	MR25	METAL FILM
R 910	5322 116 55357	82,5	1	MR25	METAL FILM
R 911	5322 116 64051	15	5	0.125W	METAL OXIDE
R 912	5322 116 50572	12,1K	1	MR25	METAL FILM
R 913	5322 116 64098	33	5	0.125W	METAL OXIDE
R 914	4822 116 51234	750	1	MR25	METAL FILM
R 915	5322 116 54557	1,21K	1	MR25	METAL FILM
R 916	5322 116 50568	4,99	1	MR25	METAL FILM
R 917	5322 116 54442	51,1	1	MR25	METAL FILM
R 918	5322 116 54743	301K	1	MR25	METAL FILM
R 919	5322 116 54442	51,1	1	MR25	METAL FILM
R 920	5322 116 50925	15,4	1	MR25	METAL FILM
R 921	5322 116 54706	127K	1	MR25	METAL FILM
R 922	5322 101 14048	47K	20	0,5W	TRIMMING POTM
R 923	5322 116 54442	51,1	1	MR25	METAL FILM
R 924	5322 116 54442	51,1	1	MR25	METAL FILM
R 925	5322 100 10135	470	20	0.75W	TRIMMING POTM
R 926	5322 116 54442	51,1	1	MR25	METAL FILM
R 927	5322 116 54442	51,1	1	MR25	METAL FILM
R 928	4822 116 51235	1K	1	MR25	METAL FILM
R 929	5322 116 50586	1,54K	1	MR25	METAL FILM
R 930	5322 100 10135	470	20	0.75W	TRIMMING POTM
R 931	5322 116 54506	287	1	MR25	METAL FILM
R 932	5322 116 64099	510	5	0.125W	METAL OXIDE
R 933	5322 116 54335	750K	1	MR30	METAL FILM
R 934	5322 111 30376	100M	5	0,125W	CARBON
R 935	5322 116 54442	51,1	1	MR25	METAL FILM
R 936	5322 116 54735	255K	1	MR25	METAL FILM
R 937	5322 116 55454	1M	1	SPEC	METAL FILM
R 938	5322 116 54576	2,37K	1	MR25	METAL FILM
R 939	5322 116 50568	4,99	1	MR25	METAL FILM
R 940	5322 116 54442	51,1	1	MR25	METAL FILM
R 941	5322 116 64051	15	5	0.125W	METAL OXIDE
R 942	5322 116 50572	12,1K	1	MR25	METAL FILM

ITEM	ORDERING NUMBER	OHM	TOL (%)	TYPE	REMARKS
R 943	5322 116 64098	33	5	0.125W	METAL OXIDE
R 944	4822 116 51234	750	1	MR25	METAL FILM
R 945	5322 116 54442	51,1	1	MR25	METAL FILM
R 946	5322 116 50568	4,99	1	MR25	METAL FILM
R 947	5322 116 54442	51,1	1	MR25	METAL FILM
R 948	5322 116 54743	301K	1	MR25	METAL FILM
R 949	5322 116 54442	51,1	1	MR25	METAL FILM
R 950	5322 116 54442	51,1	1	MR25	METAL FILM
R 951	5322 116 54706	127K	1	MR25	METAL FILM
R 952	5322 101 14048	47K	20	0,5W	TRIMMING POTM
R 953	5322 116 54442	51,1	1	MR25	METAL FILM
R 954	5322 116 54442	51,1	1	MR25	METAL FILM
R 955	5322 100 10135	470	20	0.75W	TRIMMING POTM
R 956	5322 116 50925	15,4	1	MR25	METAL FILM
R 957	5322 116 54613	8,66K	1	MR25	METAL FILM
R 958	5322 116 54557	1,21K	1	MR25	METAL FILM
R 959	5322 116 54557	1,21K	1	MR25	METAL FILM
R 960	5322 100 10135	470	20	0.75W	TRIMMING POTM
R 961	5322 116 54506	287	1	MR25	METAL FILM
R 962	5322 116 64099	510	5	0.125W	METAL OXIDE
R 963	5322 116 54335	750K	1	MR30	METAL FILM
R 964	5322 111 30376	100M	5	0,125W	CARBON
R 965	5322 116 54442	51,1	1	MR25	METAL FILM
R 966	5322 116 54735	255K	1	MR25	METAL FILM
R 967	5322 116 55454	1M	1	SPEC	METAL FILM
R 968	5322 116 54576	2,37K	1	MR25	METAL FILM
R 969	5322 116 50568	4,99	1	MR25	METAL FILM
R 971	5322 116 64051	15	5	0.125W	METAL OXIDE
R 972	5322 116 50572	12,1K	1	MR25	METAL FILM
R 973	5322 116 64098	33	5	0.125W	METAL OXIDE
R 974	4822 116 51234	750	1	MR25	METAL FILM
R 975	5322 100 10135	470	20	0.75W	TRIMMING POTM
R 976	5322 116 50568	4,99	1	MR25	METAL FILM
R 977	5322 116 54442	51,1	1	MR25	METAL FILM
R 978	5322 116 54743	301K	1	MR25	METAL FILM
R 979	5322 116 54442	51,1	1	MR25	METAL FILM
R 981	5322 116 54706	127K	1	MR25	METAL FILM
R 982	5322 101 14048	47K	20	0,5W	TRIMMING POTM
R 983	5322 116 54442	51,1	1	MR25	METAL FILM
R 984	5322 116 54442	51,1	1	MR25	METAL FILM
R 985	4822 116 51247	3,32K	1	MR25	METAL FILM
R 986	5322 116 54442	51,1	1	MR25	METAL FILM
R 987	5322 116 54442	51,1	1	MR25	METAL FILM
R 988	5322 116 54442	51,1	1	MR25	METAL FILM
R 989	5322 116 54442	51,1	1	MR25	METAL FILM
R 990	5322 116 55357	82,5	1	MR25	METAL FILM
R 991	5322 116 54442	51,1	1	MR25	METAL FILM
R 992	5322 116 54613	8,66K	1	MR25	METAL FILM
R 993	5322 116 54442	51,1	1	MR25	METAL FILM
R 994	5322 116 54442	51,1	1	MR25	METAL FILM
R 995	5322 116 54442	51,1	1	MR25	METAL FILM
R 996	5322 116 50675	2,26K	1	MR25	METAL FILM
R 997	4822 116 51247	3,32K	1	MR25	METAL FILM
R 998	5322 116 50675	2,26K	1	MR25	METAL FILM
R 999	4822 116 51247	3,32K	1	MR25	METAL FILM
R 1000	5322 116 54442	51,1	1	MR25	METAL FILM
R 1001	5322 116 54442	51,1	1	MR25	METAL FILM
R 1002	5322 116 54442	51,1	1	MR25	METAL FILM
R 1003	5322 116 54442	51,1	1	MR25	METAL FILM
R 1004	5322 116 54442	51,1	1	MR25	METAL FILM
R 1005	5322 116 54442	51,1	1	MR25	METAL FILM
R 1006	5322 116 54442	51,1	1	MR25	METAL FILM
R 1007	5322 116 54442	51,1	1	MR25	METAL FILM
R 1008	5322 116 54442	51,1	1	MR25	METAL FILM
R 1009	5322 116 54442	51,1	1	MR25	METAL FILM
R 1010	4822 116 51235	1K	1	MR25	METAL FILM
R 1011	5322 116 54442	51,1	1	MR25	METAL FILM
R 1012	4822 116 51235	1K	1	MR25	METAL FILM
R 1013	5322 116 54442	51,1	1	MR25	METAL FILM
R 1014	5322 116 55357	82,5	1	MR25	METAL FILM

ITEM	ORDERING NUMBER	OHM	TOL (%)	TYPE	REMARKS
R 1015	5322 116 54442	51,1	1	MR25	METAL FILM
R 1016	5322 116 54442	51,1	1	MR25	METAL FILM
R 1017	5322 116 54442	51,1	1	MR25	METAL FILM
R 1018	5322 116 54442	51,1	1	MR25	METAL FILM
R 1020	5322 116 54442	51,1	1	MR25	METAL FILM
R 1021	5322 116 54442	51,1	1	MR25	METAL FILM
R 1022	4822 116 51235	1K	1	MR25	METAL FILM
R 1023	5322 116 50675	2,26K	1	MR25	METAL FILM
R 1024	5322 116 50675	2,26K	1	MR25	METAL FILM
R 1025	5322 116 54442	51,1	1	MR25	METAL FILM
R 1026	5322 116 50675	2,26K	1	MR25	METAL FILM
R 1027	5322 116 50675	2,26K	1	MR25	METAL FILM
R 1028	4822 116 51247	3,32K	1	MR25	METAL FILM
R 1029	5322 116 50675	2,26K	1	MR25	METAL FILM
R 1030	4822 116 51247	3,32K	1	MR25	METAL FILM
R 1031	4822 116 51247	3,32K	1	MR25	METAL FILM
R 1032	4822 116 51247	3,32K	1	MR25	METAL FILM
R 1033	5322 116 54442	51,1	1	MR25	METAL FILM
R 1034	5322 116 54442	51,1	1	MR25	METAL FILM
R 1035	5322 116 50675	2,26K	1	MR25	METAL FILM
R 1036	5322 116 54442	51,1	1	MR25	METAL FILM
R 1037	5322 116 54442	51,1	1	MR25	METAL FILM
R 1038	5322 116 54442	51,1	1	MR25	METAL FILM
R 1039	5322 116 54442	51,1	1	MR25	METAL FILM
R 1040	5322 116 54557	1,21K	1	MR25	METAL FILM
R 1041	5322 116 54442	51,1	1	MR25	METAL FILM
R 1042	5322 116 55365	205	1	MR25	METAL FILM
R 1043	5322 116 50675	2,26K	1	MR25	METAL FILM
R 1044	4822 116 51247	3,32K	1	MR25	METAL FILM
R 1045	5322 116 50728	1,87K	1	MR25	METAL FILM
R 1046	5322 116 54442	51,1	1	MR25	METAL FILM
R 1047	5322 116 54442	51,1	1	MR25	METAL FILM
R 1048	5322 116 54442	51,1	1	MR25	METAL FILM
R 1049	5322 116 54442	51,1	1	MR25	METAL FILM
R 1050	5322 116 50636	2,74K	1	MR25	METAL FILM
R 1051	5322 116 54442	51,1	1	MR25	METAL FILM
R 1052	5322 116 50636	2,74K	1	MR25	METAL FILM
R 1053	5322 116 50636	2,74K	1	MR25	METAL FILM
R 1054	5322 116 50636	2,74K	1	MR25	METAL FILM
R 1056	5322 116 54557	1,21K	1	MR25	METAL FILM
R 1057	5322 116 54557	1,21K	1	MR25	METAL FILM
R 1058	5322 116 54557	1,21K	1	MR25	METAL FILM
R 1059	5322 116 54557	1,21K	1	MR25	METAL FILM
R 1061	5322 116 55359	1,62K	1	MR25	METAL FILM
R 1062	5322 116 54595	5,11K	1	MR25	METAL FILM
R 1063	5322 116 54442	51,1	1	MR25	METAL FILM
R 1064	5322 116 50536	464	1	MR25	METAL FILM
R 1066	5322 116 50568	4,99	1	MR25	METAL FILM
R 1067	5322 116 50568	4,99	1	MR25	METAL FILM
R 1068	5322 116 54442	51,1	1	MR25	METAL FILM
R 1069	5322 116 54442	51,1	1	MR25	METAL FILM
R 1070	5322 116 54442	51,1	1	MR25	METAL FILM
R 1071	5322 116 55549	100	1	MR25	METAL FILM
R 1072	5322 116 55549	100	1	MR25	METAL FILM
R 1073	5322 116 54442	51,1	1	MR25	METAL FILM
R 1074	5322 116 55549	100	1	MR25	METAL FILM
R 1075	5322 116 54442	51,1	1	MR25	METAL FILM
R 1076	4822 116 51235	1K	1	MR25	METAL FILM
R 1077	4822 116 51235	1K	1	MR25	METAL FILM
R 1078	4822 116 51235	1K	1	MR25	METAL FILM
R 1079	4822 116 51235	1K	1	MR25	METAL FILM
R 1080	5322 116 54557	1,21K	1	MR25	METAL FILM
R 1081	4822 116 51235	1K	1	MR25	METAL FILM
R 1082	4822 116 51235	1K	1	MR25	METAL FILM
R 1083	4822 116 51235	1K	1	MR25	METAL FILM
R 1084	4822 116 51235	1K	1	MR25	METAL FILM
R 1085	5322 116 50636	2,74K	1	MR25	METAL FILM
R 1086	4822 116 51235	1K	1	MR25	METAL FILM
R 1087	4822 116 51235	1K	1	MR25	METAL FILM
R 1088	5322 116 50675	2,26K	1	MR25	METAL FILM

ITEM	ORDERING NUMBER	OHM	TOL (%)	TYPE	REMARKS
R 1089	4822 116 51247	3,32K	1	MR25	METAL FILM
R 1090	5322 116 54608	7,5K	1	MR25	METAL FILM
R 1091	5322 116 54442	51,1	1	MR25	METAL FILM
R 1092	5322 116 54442	51,1	1	MR25	METAL FILM
R 1093	4822 116 51235	1K	1	MR25	METAL FILM
R 1094	4822 116 51235	1K	1	MR25	METAL FILM
R 1095	5322 116 50636	2,74K	1	MR25	METAL FILM
R 1096	4822 116 51235	1K	1	MR25	METAL FILM
R 1097	4822 116 51235	1K	1	MR25	METAL FILM
R 1098	4822 116 51235	1K	1	MR25	METAL FILM
R 1099	5322 116 54557	1,21K	1	MR25	METAL FILM
R 1101	4822 116 51235	1K	1	MR25	METAL FILM
R 1102	4822 116 51253	10K	1	MR25	METAL FILM
R 1103	5322 116 50636	2,74K	1	MR25	METAL FILM
R 1104	5322 116 54606	7,15K	1	MR25	METAL FILM
R 1106	5322 116 50415	1,15K	1	MR25	METAL FILM
R 1107	5322 116 54595	5,11K	1	MR25	METAL FILM
R 1108	5322 116 50491	22,6	1	MR25	METAL FILM
R 1109	5322 116 55422	1,33K	1	MR25	METAL FILM
R 1111	4822 116 51246	3,01K	1	MR25	METAL FILM
R 1112	5322 116 50556	4,42K	1	MR25	METAL FILM
R 1113	5322 116 50636	2,74K	1	MR25	METAL FILM
R 1114	5322 116 50592	442	1	MR25	METAL FILM
R 1116	5322 116 54567	1,69K	1	MR25	METAL FILM
R 1117	5322 116 54606	7,15K	1	MR25	METAL FILM
R 1118	5322 116 50491	22,6	1	MR25	METAL FILM
R 1119	5322 116 50484	4,64K	1	MR25	METAL FILM
R 1121	4822 116 51247	3,32K	1	MR25	METAL FILM
R 1122	5322 116 50536	464	1	MR25	METAL FILM
R 1123	5322 116 54557	1,21K	1	MR25	METAL FILM
R 1124	5322 116 50664	2,05K	1	MR25	METAL FILM
R 1125	5322 116 50572	12,1K	1	MR25	METAL FILM
R 1126	5322 116 55365	205	1	MR25	METAL FILM
R 1127	4822 116 51235	1K	1	MR25	METAL FILM
R 1128	5322 116 50572	12,1K	1	MR25	METAL FILM
R 1129	4822 116 51231	562	1	MR25	METAL FILM
R 1130	4822 116 51234	750	1	MR25	METAL FILM
R 1131	4822 116 51266	68,1K	1	MR25	METAL FILM
R 1132	5322 116 55448	4,02K	1	MR25	METAL FILM
R 1133	4822 116 51235	1K	1	MR25	METAL FILM
R 1134	5322 101 14094	1M	20	0,5W	TRIMMING POTM
R 1135	5322 116 50583	5,9K	1	MR25	METAL FILM
R 1136	5322 116 50491	22,6	1	MR25	METAL FILM
R 1137	5322 116 50511	48,7	1	MR25	METAL FILM
R 1138	5322 116 54648	24,9K	1	MR25	METAL FILM
R 1139	5322 116 54648	24,9K	1	MR25	METAL FILM
R 1140	5322 116 50491	22,6	1	MR25	METAL FILM
R 1141	4822 116 51235	1K	1	MR25	METAL FILM
R 1142	5322 116 50481	22,6K	1	MR25	METAL FILM
R 1143	4822 110 42218	15M	5	VR37	CARBON
R 1144	4822 116 51235	1K	1	MR25	METAL FILM
R 1146	4822 116 51259	33,2K	1	MR25	METAL FILM
R 1147	5322 116 50491	22,6	1	MR25	METAL FILM
R 1148	5322 101 14071	100K	20	0.5W	TRIMMING POTM
R 1149	5322 116 54743	301K	1	MR25	METAL FILM
R 1151	4822 116 51268	100K	1	MR25	METAL FILM
R 1152	5322 116 54595	5,11K	1	MR25	METAL FILM
R 1153	5322 116 55362	18,7K	1	MR25	METAL FILM
R 1154	5322 116 54678	59K	1	MR25	METAL FILM
R 1156	5322 116 54595	5,11K	1	MR25	METAL FILM
R 1157	4822 116 51235	1K	1	MR25	METAL FILM
R 1158	5322 116 54743	301K	1	MR25	METAL FILM
R 1159	5322 116 50536	464	1	MR25	METAL FILM
R 1161	5322 116 55422	1,33K	1	MR25	METAL FILM
R 1162	5322 116 50491	22,6	1	MR25	METAL FILM
R 1163	4822 116 51268	100K	1	MR25	METAL FILM
R 1164	5322 116 50491	22,6	1	MR25	METAL FILM
R 1166	4822 116 51266	68,1K	1	MR25	METAL FILM
R 1167	5322 116 50572	12,1K	1	MR25	METAL FILM
R 1168	5322 116 54678	59K	1	MR25	METAL FILM

ITEM	ORDERING NUMBER	OHM	TOL (%)	TYPE	REMARKS
R 1169	5322 101 14071	100K	20	0.5W	TRIMMING POTM
R 1170	5322 116 55284	681K	1	MR25	METAL FILM
R 1171	5322 116 54743	301K	1	MR25	METAL FILM
R 1172	4822 116 51235	1K	1	MR25	METAL FILM
R 1173	4822 116 51235	1K	1	MR25	METAL FILM
R 1174	4822 110 73187	1M	5	CR25	CARBON PIN-HEAD
R 1175	4822 110 42207	5,6M	5	VR37	CARBON
R 1176	4822 116 51268	100K	1	MR25	METAL FILM
R 1177	4822 116 51253	10K	1	MR25	METAL FILM
R 1178	4822 110 73187	1M	5	CR25	CARBON PIN-HEAD
R 1179	4822 116 51253	10K	1	MR25	METAL FILM
R 1180	4822 110 42218	15M	5	VR37	CARBON
R 1182	4822 110 63203	3,9M	10	CR25	CARBON
R 1183	4822 110 63203	3,9M	10	CR25	CARBON
R 1184	4822 110 73163	120K	5	CR25	CARBON PIN-HEAD
R 1186	4822 116 51268	100K	1	MR25	METAL FILM
R 1187	5322 116 50511	48,7	1	MR25	METAL FILM
R 1188	5322 101 14094	1M	20	0,5W	TRIMMING POTM
R 1189	5322 100 10113	10K	20	0,5W	TRIMMING POTM
R 1191	5322 116 50568	4,99	1	MR25	METAL FILM
R 1192	5322 116 50568	4,99	1	MR25	METAL FILM
R 1193	5322 116 50568	4,99	1	MR25	METAL FILM
R 1194	5322 116 50491	22,6	1	MR25	METAL FILM
R 1196	5322 116 50491	22,6	1	MR25	METAL FILM
R 1197	5322 116 50491	22,6	1	MR25	METAL FILM
R 1201	5322 116 50511	48,7	1	MR25	METAL FILM
R 1202	5322 116 54646	23,7K	1	MR25	METAL FILM
R 1203	5322 116 50491	22,6	1	MR25	METAL FILM
R 1204	5322 116 50481	22,6K	1	MR25	METAL FILM
R 1206	4822 116 51268	100K	1	MR25	METAL FILM
R 1207	5322 116 50511	48,7	1	MR25	METAL FILM
R 1208	5322 116 50767	2,15K	1	MR25	METAL FILM
R 1209	5322 116 50557	46,4K	1	MR25	METAL FILM
R 1211	5322 116 50491	22,6	1	MR25	METAL FILM
R 1212	5322 116 54455	68,1	1	MR25	METAL FILM
R 1213	4822 116 51246	3,01K	1	MR25	METAL FILM
R 1214	4822 116 51246	3,01K	1	MR25	METAL FILM
R 1216	5322 116 50415	1,15K	1	MR25	METAL FILM
R 1217	5322 101 14047	470	20	0,5W	TRIMMING POTM
R 1218	5322 101 14047	470	20	0,5W	TRIMMING POTM
R 1219	5322 116 50415	1,15K	1	MR25	METAL FILM
R 1221	4822 116 51235	1K	1	MR25	METAL FILM
R 1222	4822 116 51246	3,01K	1	MR25	METAL FILM
R 1223	4822 116 51246	3,01K	1	MR25	METAL FILM
R 1224	5322 116 50511	48,7	1	MR25	METAL FILM
R 1226	5322 116 50481	22,6K	1	MR25	METAL FILM
R 1227	5322 116 50491	22,6	1	MR25	METAL FILM
R 1228	5322 116 54646	23,7K	1	MR25	METAL FILM
R 1229	4822 116 51268	100K	1	MR25	METAL FILM
R 1231	5322 116 50511	48,7	1	MR25	METAL FILM
R 1232	5322 116 50767	2,15K	1	MR25	METAL FILM
R 1233	5322 116 50557	46,4K	1	MR25	METAL FILM
R 1234	5322 116 50491	22,6	1	MR25	METAL FILM
R 1236	4822 116 51233	681	1	MR25	METAL FILM
R 1237	4822 116 51246	3,01K	1	MR25	METAL FILM
R 1238	4822 116 51246	3,01K	1	MR25	METAL FILM
R 1251	5322 116 50511	48,7	1	MR25	METAL FILM
R 1252	4822 116 51253	10K	1	MR25	METAL FILM
R 1253	5322 116 50491	22,6	1	MR25	METAL FILM
R 1254	5322 116 54637	17,8K	1	MR25	METAL FILM
R 1256	5322 116 50511	48,7	1	MR25	METAL FILM
R 1257	5322 116 55359	1,62K	1	MR25	METAL FILM
R 1258	5322 116 50555	1,27K	1	MR25	METAL FILM
R 1259	5322 101 14047	470	20	0,5W	TRIMMING POTM
R 1261	5322 101 14047	470	20	0,5W	TRIMMING POTM
R 1262	5322 116 50555	1,27K	1	MR25	METAL FILM
R 1263	4822 116 51235	1K	1	MR25	METAL FILM
R 1264	5322 116 50636	2,74K	1	MR25	METAL FILM
R 1266	5322 116 50636	2,74K	1	MR25	METAL FILM
R 1267	5322 116 50511	48,7	1	MR25	METAL FILM

ITEM	ORDERING NUMBER	OHM	TOL (%)	TYPE	REMARKS
R 1268	4822 116 51253	10K	1	MR25	METAL FILM
R 1269	5322 116 50491	22,6	1	MR25	METAL FILM
R 1271	5322 116 54637	17,8K	1	MR25	METAL FILM
R 1272	5322 116 50511	48,7	1	MR25	METAL FILM
R 1273	5322 116 55359	1,62K	1	MR25	METAL FILM
R 1300	4822 116 51235	1K	1	MR25	METAL FILM
R 1301	4822 116 51235	1K	1	MR25	METAL FILM
R 1302	5322 116 50578	78,7	1	MR25	METAL FILM
R 1303	5322 116 50492	46,4	1	MR25	METAL FILM
R 1304	5322 116 50578	78,7	1	MR25	METAL FILM
R 1305	5322 116 55564	1,15	1	MR25	METAL FILM
R 1306	5322 116 50492	46,4	1	MR25	METAL FILM
R 1307	4822 116 51253	10K	1	MR25	METAL FILM
R 1308	5322 116 55357	82,5	1	MR25	METAL FILM
R 1309	5322 116 54479	127	1	MR25	METAL FILM
R 1310	5322 116 50452	10	1	MR25	METAL FILM
R 1311	5322 116 55451	487	1	MR25	METAL FILM
R 1312	5322 116 55451	487	1	MR25	METAL FILM
R 1313	5322 116 55451	487	1	MR25	METAL FILM
R 1314	5322 116 50679	237	1	MR25	METAL FILM
R 1315	4822 116 51253	10K	1	MR25	METAL FILM
R 1316	5322 116 55451	487	1	MR25	METAL FILM
R 1317	5322 116 54716	162K	1	MR25	METAL FILM
R 1318	5322 116 54665	40,2K	1	MR25	METAL FILM
R 1319	4822 116 51253	10K	1	MR25	METAL FILM
R 1321	4822 116 51253	10K	1	MR25	METAL FILM
R 1322	4822 116 51253	10K	1	MR25	METAL FILM
R 1323	4822 116 51253	10K	1	MR25	METAL FILM
R 1324	4822 116 51253	10K	1	MR25	METAL FILM
R 1326	5322 116 50672	51,1K	1	MR25	METAL FILM
R 1327	5322 116 50636	2,74K	1	MR25	METAL FILM
R 1328	5322 100 10114	4,7K	20	0.5W	TRIMMING POTM
R 1329	5322 116 54472	105	1	MR25	METAL FILM
R 1330	5322 116 50621	536	1	MR25	METAL FILM
R 1331	5322 116 50675	2,26K	1	MR25	METAL FILM
R 1332	5322 116 55367	3,48K	1	MR25	METAL FILM
R 1333	5322 116 55367	3,48K	1	MR25	METAL FILM
R 1334	5322 116 55367	3,48K	1	MR25	METAL FILM
R 1336	5322 116 55367	3,48K	1	MR25	METAL FILM
R 1337	4822 116 51252	6,81K	1	MR25	METAL FILM
R 1338	4822 116 51252	6,81K	1	MR25	METAL FILM
R 1339	5322 116 55367	3,48K	1	MR25	METAL FILM
R 1340	5322 116 50452	10	1	MR25	METAL FILM
R 1341	5322 116 55367	3,48K	1	MR25	METAL FILM
R 1342	4822 116 51235	1K	1	MR25	METAL FILM
R 1343	4822 116 51235	1K	1	MR25	METAL FILM
R 1344	4822 116 51235	1K	1	MR25	METAL FILM
R 1345	5322 116 50452	10	1	MR25	METAL FILM
R 1346	4822 116 51235	1K	1	MR25	METAL FILM
R 1347	5322 116 50452	10	1	MR25	METAL FILM
R 1348	5322 116 50452	10	1	MR25	METAL FILM
R 1349	5322 116 50452	10	1	MR25	METAL FILM
R 1351	5322 116 50452	10	1	MR25	METAL FILM
R 1352	5322 116 50452	10	1	MR25	METAL FILM
R 1353	5322 116 50452	10	1	MR25	METAL FILM
R 1357	5322 111 94172	620	5	8X0.1W	WIRE-WOUND
R 1358	5322 111 94172	620	5	8X0.1W	WIRE-WOUND
R 1359	5322 111 94173	2,7K	5	8X0.1W	WIRE-WOUND
R 1361	5322 111 94173	2,7K	5	8X0.1W	WIRE-WOUND
R 1367	4822 116 51253	10K	1	MR25	METAL FILM
R 1368	4822 116 51253	10K	1	MR25	METAL FILM
R 1369	4822 116 51253	10K	1	MR25	METAL FILM
R 1371	4822 116 51253	10K	1	MR25	METAL FILM
R 1372	4822 116 51253	10K	1	MR25	METAL FILM
R 1373	4822 116 51253	10K	1	MR25	METAL FILM
R 1374	4822 116 51253	10K	1	MR25	METAL FILM
R 1375	4822 116 51235	1K	1	MR25	METAL FILM
R 1376	4822 116 51253	10K	1	MR25	METAL FILM
R 1377	5322 116 55419	20,5K	1	MR25	METAL FILM
R 1378	5322 116 55419	20,5K	1	MR25	METAL FILM

ITEM	ORDERING NUMBER	OHM	TOL (%)	TYPE	REMARKS
R 1379	4822 116 51281	5,62K	1	MR25	METAL FILM
R 1380	5322 116 54706	127K	1	MR25	METAL FILM
R 1381	5322 116 54595	5,11K	1	MR25	METAL FILM
R 1382	4822 116 51235	1K	1	MR25	METAL FILM
R 1383	4822 110 42223	22M	5	VR37	CARBON
R 1384	4822 116 51253	10K	1	MR25	METAL FILM
R 1386	4822 116 51253	10K	1	MR25	METAL FILM
R 1387	4822 116 51235	1K	1	MR25	METAL FILM
R 1388	4822 116 51235	1K	1	MR25	METAL FILM
R 1389	5322 100 10112	1K	20	0,5W	TRIMMING POTM
R 1391	4822 116 51253	10K	1	MR25	METAL FILM
R 1392	4822 116 51253	10K	1	MR25	METAL FILM
R 1393	4822 116 51265	61,9K	1	MR25	METAL FILM
R 1394	5322 116 54595	5,11K	1	MR25	METAL FILM
R 1395	5322 116 54595	5,11K	1	MR25	METAL FILM
R 1396	4822 116 51268	100K	1	MR25	METAL FILM
R 1397	5322 116 55387	205K	1	MR25	METAL FILM
R 1398	5322 116 55387	205K	1	MR25	METAL FILM
R 1399	4822 116 51268	100K	1	MR25	METAL FILM
R 1401	4822 116 51253	10K	1	MR25	METAL FILM
R 1402	5322 116 50484	4,64K	1	MR25	METAL FILM
R 1403	5322 116 50484	4,64K	1	MR25	METAL FILM
R 1404	5322 116 50484	4,64K	1	MR25	METAL FILM
R 1406	5322 116 55419	20,5K	1	MR25	METAL FILM
R 1407	4822 116 51268	100K	1	MR25	METAL FILM
R 1408	5322 101 14047	470	20	0,5W	TRIMMING POTM
R 1409	4822 116 51232	619	1	MR25	METAL FILM
R 1411	4822 116 51235	1K	1	MR25	METAL FILM
R 1412	4822 116 51253	10K	1	MR25	METAL FILM
R 1413	4822 116 51253	10K	1	MR25	METAL FILM
R 1414	5322 116 54595	5,11K	1	MR25	METAL FILM
R 1416	4822 116 51253	10K	1	MR25	METAL FILM
R 1417	4822 116 51235	1K	1	MR25	METAL FILM
R 1418	4822 116 51253	10K	1	MR25	METAL FILM
R 1419	4822 116 51235	1K	1	MR25	METAL FILM
R 1431	5322 116 50731	10,5K	1	MR25	METAL FILM
R 1432	5322 116 50731	10.5K	1	MR25	METAL FILM
R 1433	4822 116 51231	562	1	MR25	METAL FILM
R 1434	5322 100 10112	1K	20	0,5W	TRIMMING POTM
R 1436	5322 100 10112	1K	20	0,5W	TRIMMING POTM
R 1437	5322 116 50452	10	1	MR25	METAL FILM
R 1438	5322 116 50452	10	1	MR25	METAL FILM
R 1439	5322 116 54511	316	1	MR25	METAL FILM
R 1441	4822 116 51235	1K	1	MR25	METAL FILM
R 1442	5322 116 54595	5,11K	1	MR25	METAL FILM
R 1443	5322 116 54595	5,11K	1	MR25	METAL FILM
R 1451	5322 116 50731	10,5K	1	MR25	METAL FILM
R 1452	5322 116 50731	10,5K	1	MR25	METAL FILM
R 1453	4822 116 51231	562	1	MR25	METAL FILM
R 1454	5322 100 10112	1K	20	0,5W	TRIMMING POTM
R 1456	5322 100 10112	1K	20	0,5W	TRIMMING POTM
R 1457	5322 116 50452	10	1	MR25	METAL FILM
R 1458	5322 116 50452	10	1	MR25	METAL FILM
R 1459	5322 116 54511	316	1	MR25	METAL FILM
R 1461	4822 116 51235	1K	1	MR25	METAL FILM
R 1462	5322 116 54595	5,11K	1	MR25	METAL FILM
R 1463	5322 116 54595	5,11K	1	MR25	METAL FILM
R 1801	5322 116 54743	301K	1	MR25	METAL FILM
R 1802	5322 116 54743	301K	1	MR25	METAL FILM
R 1803	4822 110 42187	1M	5	VR37	CARBON
R 1804	4822 112 21121	3,3K	5	4W	WIRE-WOUND
R 1806	5322 116 34051	1500 at 25°C			PTC
R 1807	5322 116 55485	110K	1	MR30	METAL FILM
R 1808	5322 116 55485	110K	1	MR30	METAL FILM
R 1812	5322 116 55549	100	1	MR25	METAL FILM
R 1813	5322 116 50452	10	1	MR25	METAL FILM
R 1814	5322 116 54351	20	5	PR52	METAL FILM
R 1816	5322 116 55205	2K	5	PR52	METAL FILM
R 1817	4822 110 63214	10M	10	CR25	CARBON
R 1818	4822 110 63214	10M	10	CR25	CARBON

ITEM	ORDERING NUMBER	OHM	TOL (%)	TYPE	REMARKS
R 1819	5322 116 54595	5,11K	1	MR25	METAL FILM
R 1821	4822 116 51259	33,2K	1	MR25	METAL FILM
R 1822	5322 116 55387	205K	1	MR25	METAL FILM
R 1823	4822 116 51235	1K	1	MR25	METAL FILM
R 1824	4822 116 51268	100K	1	MR25	METAL FILM
R 1826	5322 100 10141	10K	20	0.75W	TRIMMING POTM
R 1827	5322 116 50481	22,6K	1	MR25	METAL FILM
R 1828	5322 101 14049	470	20	0.5W	TRIMMING POTM
R 1829	5322 100 10141	10K	20	0.75W	TRIMMING POTM
R 1831	5322 116 55361	16,2K	1	MR25	METAL FILM
R 1832	5322 116 54558	8,25K	1	MR25	METAL FILM
R 1833	5322 116 54595	5,11K	1	MR25	METAL FILM
R 1834	4822 116 51247	3,32K	1	MR25	METAL FILM
R 1836	4822 116 51252	6,81K	1	MR25	METAL FILM
R 1837	5322 116 54499	249	1	MR25	METAL FILM
R 1838	5322 116 50572	12,1K	1	MR25	METAL FILM
R 1839	5322 116 54499	249	1	MR25	METAL FILM
R 1841	5322 116 54484	140	1	MR25	METAL FILM
R 1842	4822 116 51179	1	1	MR25	METAL FILM
R 1861	4822 110 42214	10M	5	VR37	CARBON
R 1863	5322 116 54532	649	1	MR25	METAL FILM
R 1864	5322 116 54492	178	1	MR25	METAL FILM
R 1866	5322 116 50635	1,47K	1	MR25	METAL FILM
R 1867	5322 101 14049	470	20	0.5W	TRIMMING POTM
R 1868	5322 116 55549	100	1	MR25	METAL FILM
R 1869	5322 116 54459	75	1	MR25	METAL FILM
R 1871	5322 116 55549	100	1	MR25	METAL FILM
R 1872	5322 116 50579	3,16K	1	MR25	METAL FILM
R 1873	5322 116 50671	2,61K	1	MR25	METAL FILM
R 1874	5322 116 55549	100	1	MR25	METAL FILM
R 1876	5322 116 55369	38,3K	1	MR25	METAL FILM
R 1877	4822 116 51268	100K	1	MR25	METAL FILM
R 1878	4822 116 51282	511	1	MR25	METAL FILM
R 1879	5322 116 54532	649	1	MR25	METAL FILM
R 1881	5322 116 54492	178	1	MR25	METAL FILM
R 1882	5322 116 50635	1,47K	1	MR25	METAL FILM
R 1883	5322 101 14049	470	20	0.5W	TRIMMING POTM
R 1884	5322 116 55549	100	1	MR25	METAL FILM
R 1886	5322 116 50954	38,3	1	MR25	METAL FILM
R 1887	5322 116 55549	100	1	MR25	METAL FILM
R 1888	5322 116 50579	3,16K	1	MR25	METAL FILM
R 1889	5322 116 50671	2,61K	1	MR25	METAL FILM

ITEM	ORDERING NUMBER	TYPE/DESCRIPTION
SEMI CONDUCTORS		
V 1	5322 131 24057	D18-120GH
V 2	4822 130 31144	CQY24B-III PH
V 101	5322 130 34037	BAV45
V 102	5322 130 44895	RANSISTOR = BFR31-SEL
V 103	5322 130 44606	BFR92R
V 104	5322 130 44606	BFR92R
V 151	5322 130 34037	BAV45
V 152	5322 130 44895	RANSISTOR = BFR31-SEL
V 153	5322 130 44606	BFR92R
V 154	5322 130 44606	BFR92R
V 201	5322 130 34037	BAV45
V 202	5322 130 44895	RANSISTOR = BFR31-SEL
V 203	5322 130 44606	BFR92R
V 204	5322 130 44606	BFR92R
V 251	5322 130 34037	BAV45
V 252	5322 130 44895	RANSISTOR = BFR31-SEL
V 253	5322 130 44606	BFR92R
V 254	5322 130 44606	BFR92R
V 301	5322 130 34037	BAV45
V 302	5322 130 44895	RANSISTOR = BFR31-SEL
V 303	5322 130 44606	BFR92R
V 304	5322 130 44606	BFR92R
V 351	5322 130 34037	BAV45
V 352	5322 130 44895	RANSISTOR = BFR31-SEL
V 353	5322 130 44606	BFR92R
V 354	5322 130 44606	BFR92R
V 401	5322 130 34037	BAV45
V 402	5322 130 44895	RANSISTOR = BFR31-SEL
V 403	5322 130 44606	BFR92R
V 404	5322 130 44606	BFR92R
V 451	5322 130 34037	BAV45
V 452	5322 130 44895	RANSISTOR = BFR31-SEL
V 453	5322 130 44606	BFR92R
V 454	5322 130 44606	BFR92R
V 501	5322 130 34037	BAV45
V 502	5322 130 44895	RANSISTOR = BFR31-SEL
V 503	5322 130 44606	BFR92R
V 504	5322 130 44606	BFR92R
V 551	5322 130 34037	BAV45
V 552	5322 130 44895	RANSISTOR = BFR31-SEL
V 553	5322 130 44606	BFR92R
V 554	5322 130 44606	BFR92R
V 601	5322 130 34037	BAV45
V 602	5322 130 44895	RANSISTOR = BFR31-SEL
V 603	5322 130 44606	BFR92R
V 604	5322 130 44606	BFR92R
V 651	5322 130 34037	BAV45
V 652	5322 130 44895	RANSISTOR = BFR31-SEL
V 653	5322 130 44606	BFR92R
V 654	5322 130 44606	BFR92R
V 701	5322 130 34037	BAV45
V 702	5322 130 44895	RANSISTOR = BFR31-SEL
V 703	5322 130 44606	BFR92R
V 704	5322 130 44606	BFR92R
V 751	5322 130 34037	BAV45
V 752	5322 130 44895	RANSISTOR = BFR31-SEL
V 753	5322 130 44606	BFR92R
V 754	5322 130 44606	BFR92R
V 801	5322 130 34037	BAV45
V 802	5322 130 44895	RANSISTOR = BFR31-SEL
V 803	5322 130 44606	BFR92R
V 804	5322 130 44606	BFR92R
V 851	5322 130 34037	BAV45
V 852	5322 130 44895	RANSISTOR = BFR31-SEL
V 853	5322 130 44606	BFR92R
V 854	5322 130 44606	BFR92R
V 901	5322 130 34037	BAV45
V 902	5322 130 44895	RANSISTOR = BFR31-SEL

ITEM	ORDERING NUMBER	TYPE/DESCRIPTION	
V 903	5322 130 44178	BFR92	
V 904	5322 130 44178	BFR92	
V 906	5322 130 34037	BAV45	
V 907	5322 130 44895	RANSISTOR = BFR31-SEL	
V 908	5322 130 44178	BFR92	
V 909	5322 130 44178	BFR92	
V 911	5322 130 34037	BAV45	
V 912	5322 130 44895	RANSISTOR = BFR31-SEL	
V 913	5322 130 44178	BFR92	
V 914	5322 130 44178	BFR92	
V 1061	5322 130 40417	BSX20	
V 1062	5322 130 40417	BSX20	
V 1063	5322 130 40417	BSX20	
V 1101	5322 130 40417	BSX20	
V 1102	5322 130 40417	BSX20	
V 1103	5322 130 40417	BSX20	
V 1104	5322 130 40417	BSX20	
V 1105	4822 130 34049	BZX75-C2V1	
V 1106	4822 130 44358	BC559B	
V 1107	4822 130 41448	BF324	
V 1108	4822 130 41448	BF324	
V 1109	4822 130 41448	BF324	
V 1110	4822 130 40968	BSS38	
V 1111	5322 130 44247	BSS68	
V 1112	4822 130 40968	BSS38	
V 1113	4822 130 40968	BSS38	
V 1114	4822 130 34173	BZX79-C5V6	
V 1115	4822 130 40968	BSS38	
V 1116	4822 130 40968	BSS38	
V 1117	5322 130 34594	BY409	PH
V 1118	5322 130 34594	BY409	PH
V 1119	5322 130 44712	V103R2	SL
V 1120	4822 130 34233	BZX79-C5V1	
V 1121	5322 130 34605	BAX12	
V 1122	5322 130 34605	BAX12	
V 1123	5322 130 44718	BUX86	PH
V 1124	4822 130 44246	BC549C	
V 1126	4822 130 44358	BC559B	
V 1127	4822 130 30195	BYX10	PH
V 1128	4822 130 30613	BAW62	
V 1129	5322 130 44247	BSS68	
V 1131	4822 130 40968	BSS38	
V 1132	5322 130 30605	BAX17	
V 1133	4822 130 30613	BAW62	
V 1134	4822 130 40968	BSS38	
V 1136	5322 130 30605	BAX17	
V 1137	5322 130 30605	BAX17	
V 1138	5322 130 30605	BAX17	
V 1139	5322 130 30605	BAX17	
V 1141	4822 130 40936	BC549B	
V 1142	4822 130 44358	BC559B	
V 1143	4822 130 41543	BF423	PH
V 1144	4822 130 41543	BF423	PH
V 1201	4822 130 41448	BF324	
V 1202	4822 130 34195	BZX79-C13	
V 1203	4822 130 41543	BF423	PH
V 1204	4822 130 41544	BF422	PH
V 1206	5322 130 40417	BSX20	
V 1207	4822 130 34278	BZX79-C6V8	
V 1208	4822 130 41448	BF324	
V 1209	4822 130 34195	BZX79-C13	
V 1211	4822 130 41543	BF423	PH
V 1212	4822 130 41544	BF422	PH
V 1213	5322 130 40417	BSX20	
V 1251	4822 130 41448	BF324	
V 1252	4822 130 34382	BZX79-C8V2	
V 1253	4822 130 44237	BF450	
V 1254	4822 130 41544	BF422	PH
V 1256	4822 130 34278	BZX79-C6V8	
V 1257	4822 130 41448	BF324	

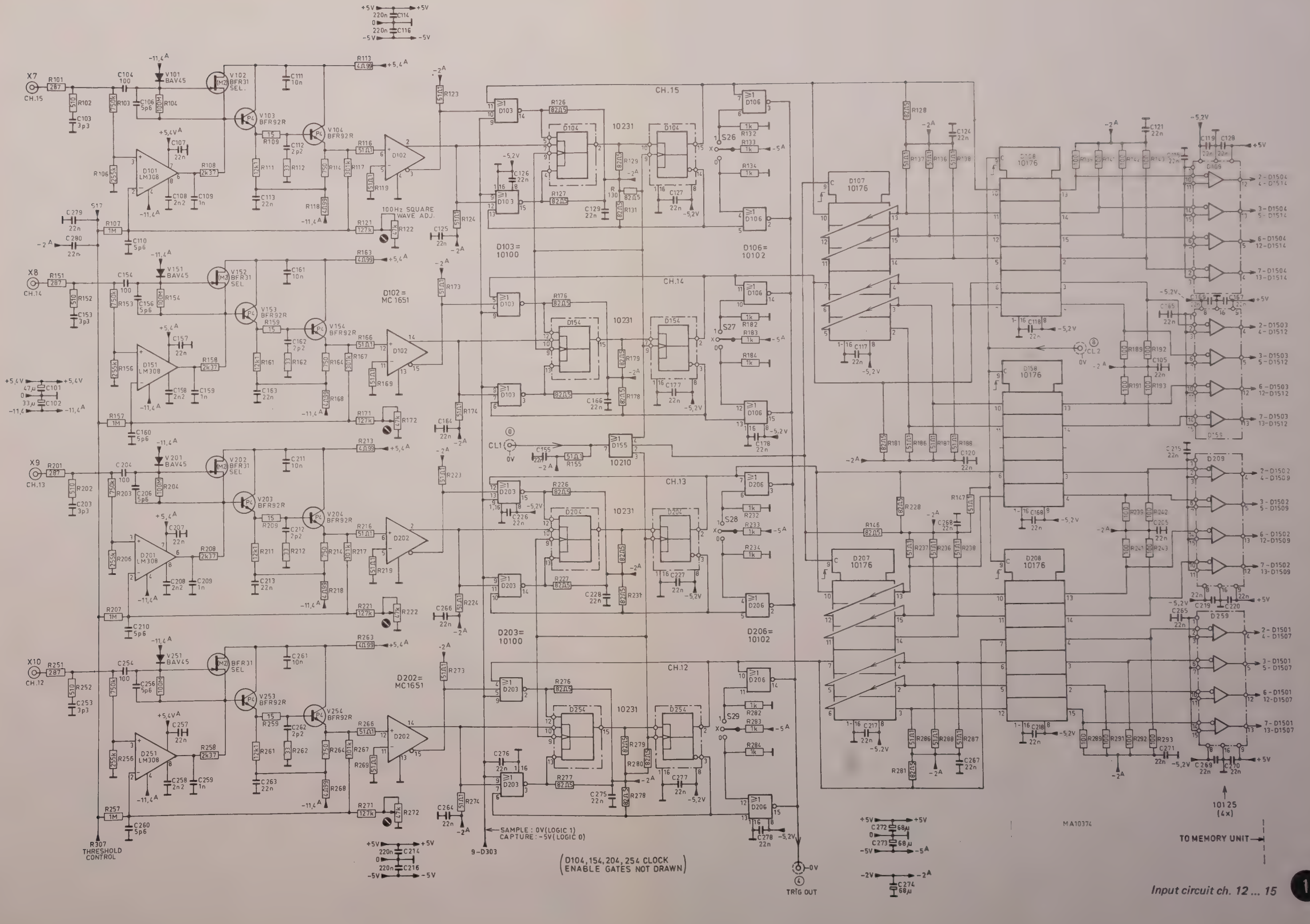
ITEM	ORDERING NUMBER	TYPE/DESCRIPTION	
V 1258	4822 130 34382	BZX79-C8V2	
V 1259	4822 130 44237	BF450	
V 1261	4822 130 41544	BF422	PH
V 1301	4822 130 40823	BD139	
V 1302	4822 130 44195	BF494	
V 1303	4822 130 30613	BAW62	
V 1304	4822 130 30613	BAW62	
V 1306	4822 130 30613	BAW62	
V 1307	4822 130 44195	BF494	
V 1308	4822 130 30613	BAW62	
V 1309	4822 130 30613	BAW62	
V 1311	5322 130 34405	1N823	
V 1312	4822 130 30613	BAW62	
V 1313	4822 130 30613	BAW62	
V 1801	5322 130 34761	BY224-600	PH
V 1802	5322 130 34761	BY224-600	PH
V 1803	5322 130 44718	BUX86	PH
V 1804	4822 130 44246	BC549C	
V 1806	4822 130 31171	BU208	PH
V 1807	5322 130 34605	BAX12	
V 1808	4822 130 31051	BY208-1000	PH
V 1809	4822 130 31051	BY208-1000	PH
V 1810	4822 130 34197	BZX79-C12	
V 1811	4822 130 31051	BY208-1000	PH
V 1812	4822 130 44246	BC549C	
V 1813	4822 130 34197	BZX79-C12	
V 1814	4822 130 30613	BAW62	
V 1816	4822 130 30839	BY206	PH
V 1817	4822 130 30839	BY206	PH
V 1818	4822 130 30839	BY206	PH
V 1819	4822 130 30839	BY206	PH
V 1851	5322 130 34594	BY409	PH
V 1852	5322 130 34594	BY409	PH
V 1853	5322 130 34594	BY409	PH
V 1854	5322 130 34594	BY409	PH
V 1856	5322 130 34594	BY409	PH
V 1857	5322 130 34594	BY409	PH
V 1858	5322 130 34594	BY409	PH
V 1859	5322 130 34594	BY409	PH
V 1861	5322 130 34594	BY409	PH
V 1863	5322 130 44817	SD41	TR
V 1864	5322 130 44817	SD41	TR
V 1866	5322 130 44817	SD41	TR
V 1867	5322 130 44817	SD41	TR
V 1868	5322 130 54064	1N5820	MO
V 1869	5322 130 54064	1N5820	MO
V 1871	5322 130 34898	BZX87-C5V6	
V 1872	5322 130 34898	BZX87-C5V6	
V 1873	4822 130 30839	BY206	PH
V 1874	4822 130 30839	BY206	PH
V 1876	4822 130 30817	BYX55-600	
V 1877	4822 130 30817	BYX55-600	
V 1878	4822 130 30817	BYX55-600	
V 1879	4822 130 30817	BYX55-600	
V 1881	5322 130 34397	BZX91	
V 1882	4822 130 40982	BD435	PH
V 1883	4822 130 30765	BZX75-C3V6	
V 1884	4822 130 44358	BC559B	
V 1886	5322 130 44325	BD201	
V 1887	5322 130 34397	BZX91	
V 1888	5322 130 44324	BD202	
V 1889	4822 130 30765	BZX75-C3V6	
V 1891	4822 130 44246	BC549C	
V 1892	4822 130 30839	BY206	PH
V 1893	4822 130 30839	BY206	PH
V 1894	4822 130 30839	BY206	PH
V 1896	4822 130 30839	BY206	PH
V 1897	4822 130 30839	BY206	PH

ITEM	ORDERING NUMBER	TYPE/DESCRIPTION	
INTEGRATED CIRCUITS			
D 101	5322 209 84659	LM308T	PH
D 102	5322 209 85408	MC1651L	MO
D 103	5322 209 86118	GXB10100P	
D 104	5322 209 86003	GXB10231P	
D 106	5322 209 85955	GXB10102P	
D 107	5322 209 86121	GXB10176P	
D 108	5322 209 86121	GXB10176P	
D 109	5322 209 86119	GXB10125P	
D 151	5322 209 84659	LM308T	PH
D 154	5322 209 86003	GXB10231P	
D 155	5322 209 86322	GXB10210D	SC
D 158	5322 209 86121	GXB10176P	
D 159	5322 209 86119	GXB10125P	
D 201	5322 209 84659	LM308T	PH
D 202	5322 209 85408	MC1651L	MO
D 203	5322 209 86118	GXB10100P	
D 204	5322 209 86003	GXB10231P	
D 206	5322 209 85955	GXB10102P	
D 207	5322 209 86121	GXB10176P	
D 208	5322 209 86121	GXB10176P	
D 209	5322 209 86119	GXB10125P	
D 251	5322 209 84659	LM308T	PH
D 254	5322 209 86003	GXB10231P	
D 259	5322 209 86119	GXB10125P	
D 301	5322 209 84659	LM308T	PH
D 302	5322 209 85408	MC1651L	MO
D 303	5322 209 86118	GXB10100P	
D 304	5322 209 86003	GXB10231P	
D 306	5322 209 85955	GXB10102P	
D 307	5322 209 86121	GXB10176P	
D 308	5322 209 86121	GXB10176P	
D 309	5322 209 86119	GXB10125P	
D 351	5322 209 84659	LM308T	PH
D 354	5322 209 86003	GXB10231P	
D 355	5322 209 86322	GXB10210D	SC
D 358	5322 209 86121	GXB10176P	
D 359	5322 209 86119	GXB10125P	
D 401	5322 209 84659	LM308T	PH
D 402	5322 209 85408	MC1651L	MO
D 403	5322 209 86118	GXB10100P	
D 404	5322 209 86003	GXB10231P	
D 406	5322 209 85955	GXB10102P	
D 407	5322 209 86121	GXB10176P	
D 408	5322 209 86121	GXB10176P	
D 409	5322 209 86119	GXB10125P	
D 451	5322 209 84659	LM308T	PH
D 454	5322 209 86003	GXB10231P	
D 459	5322 209 86119	GXB10125P	
D 501	5322 209 84659	LM308T	PH
D 502	5322 209 85408	MC1651L	MO
D 503	5322 209 86118	GXB10100P	
D 504	5322 209 86003	GXB10231P	
D 506	5322 209 85955	GXB10102P	
D 507	5322 209 86121	GXB10176P	
D 508	5322 209 86121	GXB10176P	
D 509	5322 209 86119	GXB10125P	
D 551	5322 209 84659	LM308T	PH
D 554	5322 209 86003	GXB10231P	
D 555	5322 209 86322	GXB10210D	SC
D 558	5322 209 86121	GXB10176P	
D 559	5322 209 86119	GXB10125P	
D 601	5322 209 84659	LM308T	PH
D 602	5322 209 85408	MC1651L	MO
D 603	5322 209 86118	GXB10100P	
D 604	5322 209 86003	GXB10231P	
D 606	5322 209 85955	GXB10102P	
D 607	5322 209 86121	GXB10176P	
D 608	5322 209 86121	GXB10176P	
D 609	5322 209 86119	GXB10125P	
D 651	5322 209 84659	LM308T	PH
D 654	5322 209 86003	GXB10231P	

ITEM	ORDERING NUMBER	TYPE/DESCRIPTION	
D 659	5322 209 86119	GXB10125P	
D 701	5322 209 84659	LM308T	PH
D 702	5322 209 85408	MC1651L	MO
D 703	5322 209 86118	GXB10100P	
D 704	5322 209 86003	GXB10231P	
D 706	5322 209 85955	GXB10102P	
D 707	5322 209 86121	GXB10176P	
D 708	5322 209 86121	GXB10176P	
D 709	5322 209 86119	GXB10125P	
D 751	5322 209 84659	LM308T	PH
D 754	5322 209 86003	GXB10231P	
D 755	5322 209 86322	GXB10210D	SC
D 758	5322 209 86121	GXB10176P	
D 759	5322 209 86119	GXB10125P	
D 801	5322 209 84659	LM308T	PH
D 802	5322 209 85408	MC1651L	MO
D 803	5322 209 86118	GXB10100P	
D 804	5322 209 86003	GXB10231P	
D 806	5322 209 85955	GXB10102P	
D 807	5322 209 86121	GXB10176P	
D 808	5322 209 86121	GXB10176P	
D 809	5322 209 86119	GXB10125P	
D 851	5322 209 84659	LM308T	PH
D 854	5322 209 86003	GXB10231P	
D 859	5322 209 86119	GXB10125P	
D 901	5322 209 84659	LM308T	PH
D 902	5322 209 85408	MC1651L	MO
D 903	5322 209 86267	GXB10107P	
D 904	5322 209 85955	GXB10102P	
D 906	5322 209 86269	GXB10130P	
D 907	5322 209 84659	LM308T	PH
D 908	5322 209 84659	LM308T	PH
D 909	5322 209 85408	MC1651L	MO
D 911	5322 209 86266	GXB10106P	
D 912	5322 209 86003	GXB10231P	
D 914	5322 209 86003	GXB10231P	
D 916	5322 209 86003	GXB10231P	
D 917	5322 209 86003	GXB10231P	
D 918	5322 209 86003	GXB10231P	
D 919	5322 209 85955	GXB10102P	
D 921	5322 209 86323	GXB10211D	SC
D 922	5322 209 86323	GXB10211D	SC
D 923	5322 209 86003	GXB10231P	
D 924	5322 209 86003	GXB10231P	
D 926	5322 209 86003	GXB10231P	
D 927	5322 209 86119	GXB10125P	
D 928	5322 209 84989	N74LS191N	SC
D 929	4822 209 80621	N74LS04N	SC
D 931	5322 209 85269	SN74LS75N-00	TI
D 932	5322 209 86265	GXB 10137P WITH HEAT SINK	
D 933	5322 209 85407	N74S02N	SC
D 934	5322 209 84823	N74LS00N	SC
D 936	5322 209 85741	N74S112N	SC
D 937	5322 209 84823	N74LS00N	SC
D 938	5322 209 86116	N74LS258N	SC
D 939	5322 209 86116	N74LS258N	SC
D 941	5322 209 84475	N74S04N	SC
D 942	5322 209 85269	SN74LS75N-00	TI
D 943	5322 209 85269	SN74LS75N-00	TI
D 944	5322 209 85269	SN74LS75N-00	TI
D 946	5322 209 85269	SN74LS75N-00	TI
D 947	5322 209 85491	N74LS190N	SC
D 948	5322 209 85491	N74LS190N	SC
D 949	5322 209 85491	N74LS190N	SC
D 951	5322 209 85955	GXB10102P	
D 952	5322 209 85955	GXB10102P	
D 953	5322 209 84954	N74S10N	SC
D 954	5322 209 86003	GXB10231P	
D 956	5322 209 86119	GXB10125P	
D 957	5322 209 85741	N74S112N	SC

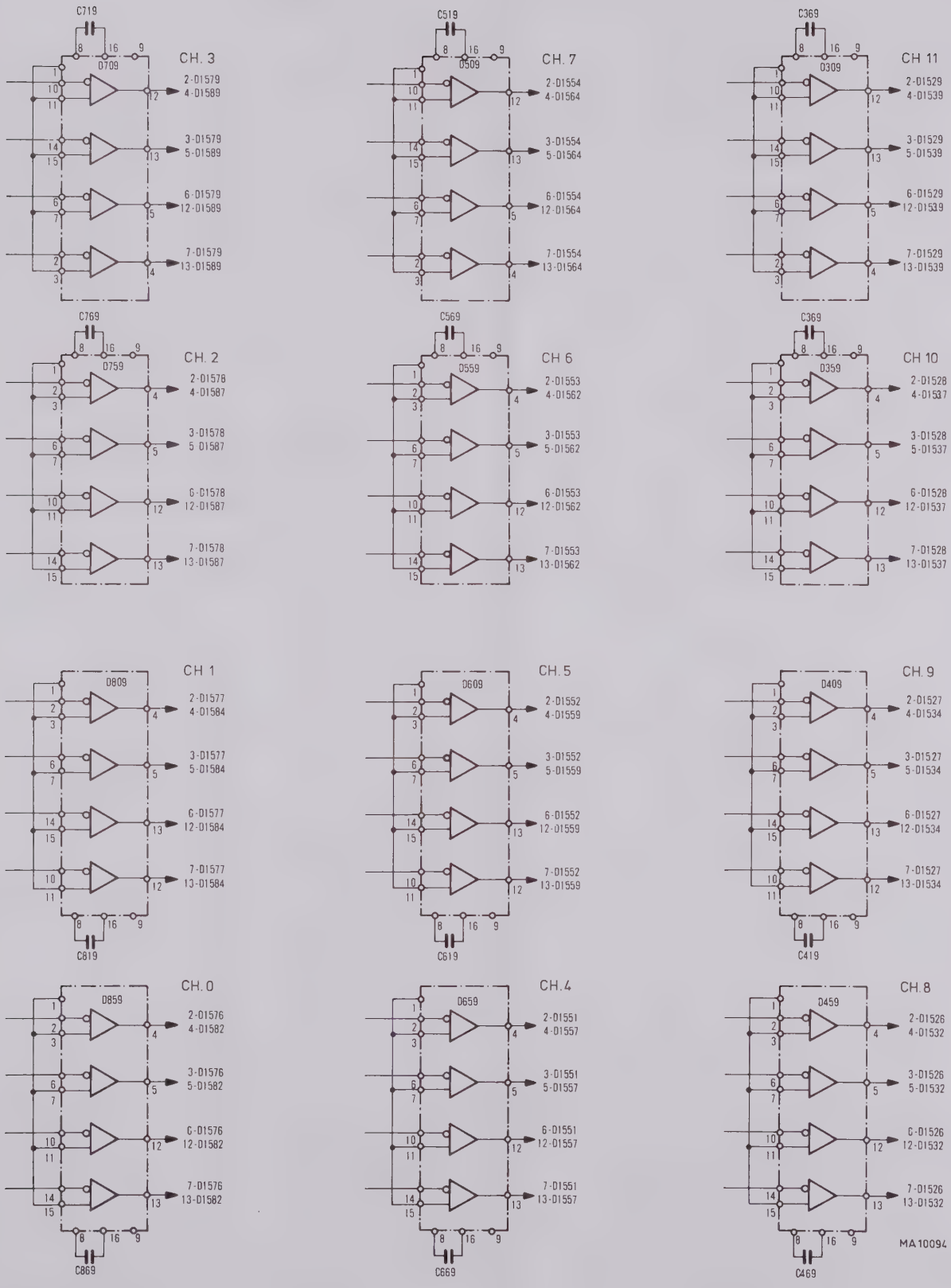
ITEM	ORDERING NUMBER	TYPE/DESCRIPTION
D 958	5322 209 86322	GXB10210D SC
D 959	5322 209 86323	GXB10211D SC
D 1061	5322 209 85955	GXB10102P
D 1062	5322 209 86003	GXB10231P
D 1063	5322 209 86003	GXB10231P
D 1064	5322 209 86003	GXB10231P
D 1066	5322 209 85255	N74LS90N SC
D 1067	5322 209 14064	HEF4518BP PH
D 1068	5322 209 14064	HEF4518BP PH
D 1069	5322 209 86452	N74LS151N SC
D 1071	5322 209 84237	N74LS112N SC
D 1072	5322 209 85406	N74LS54N SC
D 1073	5322 209 84237	N74LS112N SC
D 1074	5322 209 85741	N74S112N SC
D 1301	5322 209 54525	SET OF 6 PROMS (A.....F)
D 1308	5322 209 85995	N8X300I SC
D 1309	5322 209 86003	GXB10231P
D 1311	5322 209 85266	SN74LS123N-00 T
D 1312	5322 209 84341	N74132N SC
D 1313	5322 209 85791	NE5008N SC
D 1314	5322 209 85791	NE5008N SC
D 1316	5322 209 86125	N8T32-004N SC
D 1317	5322 209 86122	N8T32-001N SC
D 1318	5322 209 86123	N8T32-002N SC
D 1319	5322 209 86124	N8T32-003N SC
D 1321	5322 209 14783	CHAR. GEN. EPROM(2716)
D 1322	5322 209 85269	SN74LS75N-00 TI
D 1323	5322 209 85269	SN74LS75N-00 TI
D 1324	5322 209 85269	SN74LS75N-00 TI
D 1326	5322 209 85269	SN74LS75N-00 TI
D 1327	5322 209 86324	HC7943N SC
D 1328	5322 209 86116	N74LS258N SC
D 1329	5322 209 86116	N74LS258N SC
D 1331	5322 209 86116	N74LS258N SC
D 1332	5322 209 86116	N74LS258N SC
D 1333	4822 209 80631	LM339A SC
D 1334	4822 209 80617	UA741CN SC
D 1336	5322 209 85791	NE5008N SC
D 1337	5322 209 85791	NE5008N SC
D 1338	5322 209 84823	N74LS00N SC
D 1339	5322 209 84823	N74LS00N SC
D 1341	5322 209 84994	N74LS05N SC
D 1342	5322 209 86452	N74LS151N SC
D 1343	5322 209 86452	N74LS151N SC
D 1344	5322 209 84915	N74S11N SC
D 1346	5322 209 85407	N74S02N SC
D 1347	5322 209 84167	N74S00N SC
D 1348	5322 209 84954	N74S10N SC
D 1349	5322 209 84915	N74S11N SC
D 1351	5322 209 84915	N74S11N SC
D 1352	5322 209 85839	N74LS139N SC
D 1353	5322 209 84823	N74LS00N SC
D 1354	5322 209 84823	N74LS00N SC
D 1356	5322 209 84986	SN74LS74AN-00
D 1357	5322 209 85265	N74LS03N SC
D 1358	4822 209 80631	LM339A SC
D 1366	5322 209 84781	UA747CN SC
D 1501	5322 209 85269	SN74LS75N-00 TI
D 1502	5322 209 85269	SN74LS75N-00 TI
D 1503	5322 209 85269	SN74LS75N-00 TI
D 1504	5322 209 85269	SN74LS75N-00 TI
D 1506	5322 209 84999	N74LS175N SC
D 1507	5322 209 84999	N74LS175N SC
D 1508	5322 209 84999	N74LS175N SC
D 1509	5322 209 84999	N74LS175N SC
D 1511	5322 209 84999	N74LS175N SC
D 1512	5322 209 84999	N74LS175N SC
D 1513	5322 209 84999	N74LS175N SC
D 1514	5322 209 84999	N74LS175N SC
D 1516	5322 209 86324	HC7943N SC

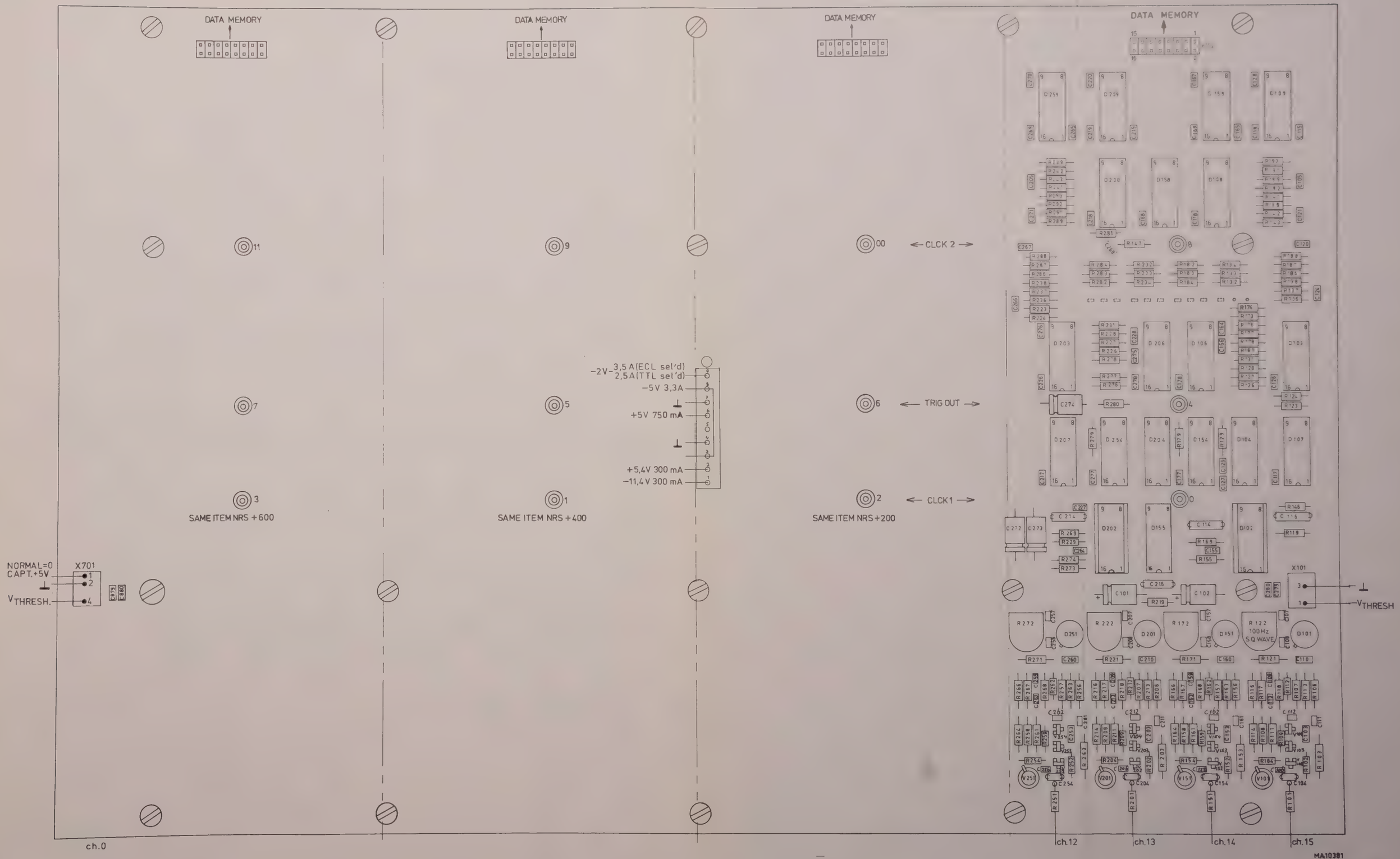
ITEM	ORDERING NUMBER	TYPE/DESCRIPTION	
D 1517	5322 209 86324	HC7943N	SC
D 1518	5322 209 86324	HC7943N	SC
D 1519	5322 209 86324	HC7943N	SC
D 1521	5322 209 84823	N74LS00N	SC
D 1526	5322 209 85269	SN74LS75N-00	TI
D 1527	5322 209 85269	SN74LS75N-00	TI
D 1528	5322 209 85269	SN74LS75N-00	TI
D 1529	5322 209 85269	SN74LS75N-00	TI
D 1531	5322 209 84999	N74LS175N	SC
D 1532	5322 209 84999	N74LS175N	SC
D 1533	5322 209 84999	N74LS175N	SC
D 1534	5322 209 84999	N74LS175N	SC
D 1536	5322 209 84999	N74LS175N	SC
D 1537	5322 209 84999	N74LS175N	SC
D 1538	5322 209 84999	N74LS175N	SC
D 1539	5322 209 84999	N74LS175N	SC
D 1541	5322 209 86324	HC7943N	SC
D 1542	5322 209 86324	HC7943N	SC
D 1543	5322 209 86324	HC7943N	SC
D 1544	5322 209 86324	HC7943N	SC
D 1546	5322 209 84823	N74LS00N	SC
D 1551	5322 209 85269	SN74LS75N-00	TI
D 1552	5322 209 85269	SN74LS75N-00	TI
D 1553	5322 209 85269	SN74LS75N-00	TI
D 1554	5322 209 85269	SN74LS75N-00	TI
D 1556	5322 209 84999	N74LS175N	SC
D 1557	5322 209 84999	N74LS175N	SC
D 1558	5322 209 84999	N74LS175N	SC
D 1559	5322 209 84999	N74LS175N	SC
D 1561	5322 209 84999	N74LS175N	SC
D 1562	5322 209 84999	N74LS175N	SC
D 1563	5322 209 84999	N74LS175N	SC
D 1564	5322 209 84999	N74LS175N	SC
D 1566	5322 209 86324	HC7943N	SC
D 1567	5322 209 86324	HC7943N	SC
D 1568	5322 209 86324	HC7943N	SC
D 1569	5322 209 86324	HC7943N	SC
D 1571	5322 209 84823	N74LS00N	SC
D 1576	5322 209 85269	SN74LS75N-00	TI
D 1577	5322 209 85269	SN74LS75N-00	TI
D 1578	5322 209 85269	SN74LS75N-00	TI
D 1579	5322 209 85269	SN74LS75N-00	TI
D 1581	5322 209 84999	N74LS175N	SC
D 1582	5322 209 84999	N74LS175N	SC
D 1583	5322 209 84999	N74LS175N	SC
D 1584	5322 209 84999	N74LS175N	SC
D 1586	5322 209 84999	N74LS175N	SC
D 1587	5322 209 84999	N74LS175N	SC
D 1588	5322 209 84999	N74LS175N	SC
D 1589	5322 209 84999	N74LS175N	SC
D 1591	5322 209 86324	HC7943N	SC
D 1592	5322 209 86324	HC7943N	SC
D 1593	5322 209 86324	HC7943N	SC
D 1594	5322 209 86324	HC7943N	SC
D 1596	5322 209 84823	N74LS00N	SC
D 1801	5322 209 85662	TDA1060	PH
D 1851	5322 209 85899	LM324N	



Input circuit ch. 12 ... 15

1


C719
D709
CH. 3
2-D1579
4-D1589
3-D1579
5-D1589
6-D1579
12-D1589
7-D1579
13-D1589
C519
D509
CH. 7
2-D1554
4-D1564
3-D1554
5-D1564
6-D1554
12-D1564
7-D1554
13-D1564
C369
D309
CH 11
2-D1529
4-D1539
3-D1529
5-D1539
6-D1529
12-D1539
7-D1529
13-D1539
C769
D759
CH. 2
2-D1578
4-D1587
3-D1578
5 D1587
6-D1578
12-D1587
7-D1578
13-D1587
C569
D559
CH 6
2-D1553
4-D1562
3-D1553
5-D1562
6-D1553
12-D1562
7-D1553
13-D1562
C369
D359
CH 10
2-D1528
4-D1537
3-D1528
5-D1537
6-D1528
12-D1537
7-D1528
13-D1537
D809
CH 1
2-D1577
4-D1584
3-D1577
5-D1584
6-D1577
12-D1584
7-D1577
13-D1584
C819
D609
CH. 5
2-D1552
4-D1559
3-D1552
5-D1559
6-D1552
12-D1559
7-D1552
13-D1559
C619
D409
CH. 9
2-D1527
4-D1534
3-D1527
5-D1534
6-D1527
12-D1534
7-D1527
13-D1534
C419
D859
CH. 0
2-D1576
4-D1582
3-D1576
5-D1582
6-D1576
12-D1582
7-D1576
13-D1582
C869
D659
CH.4
2-D1551
4-D1557
3-D1551
5-D1557
6-D1551
12-D1557
7-D1551
13-D1557
C669
D459
CH.8
2-D1526
4-D1532
3-D1526
5-D1532
6-D1526
12-D1532
7-D1526
13-D1532
C469
MA10094


DATA MEMORY
DATA MEMORY
DATA MEMORY
DATA MEMORY
11
9
7
5
3
1
SAME ITEM NRS +600
SAME ITEM NRS +400
00
CLCK 2
6
TRIG OUT
2
CLCK1
SAME ITEM NRS +200
8
4
0
−2V−3,5 A(ECL sel'd)
2,5A(TTL sel'd)
−5V 3,3A
+5V 750 mA
+5,4V 300 mA
−11,4 V 300 mA
NORMAL=0
CAPT.+5V
X701
VTHRESH.
X101
VTHRESH
C274
R280
R281
R122
100Hz
SQ WAVE
ch.0
ch.12
ch.13
ch.14
ch.15
MA10381

Ch.12 Ch.13 Ch.14 Ch.15

12-D259 13-D259 5-D259 4-D259
4-D902 5-D902 12-D902 13-D902
4-D159 5-D159 13-D159 12-D159
4-D109 5-D109 12-D109 13-D109

D1501 7475 D1502 D1503 D1504 +5V

D1506 74175 D1507 74175 D1508 D1509 D1511 D1512 D1513 D1514

(44) (22.33.55) CLOCK 3

CLR DATA MEM.

p.8

A0 p.1
A1 p.2
A2 p.3
A3 p.4
A4 p.5
A5 p.6
FROM CLOCK, TRIGGER UNIT X902

D1516 82S09 SEL. D1517 D1518 D1519

TO µP UNIT:

7400 D1521 D1521 D1521 D1521

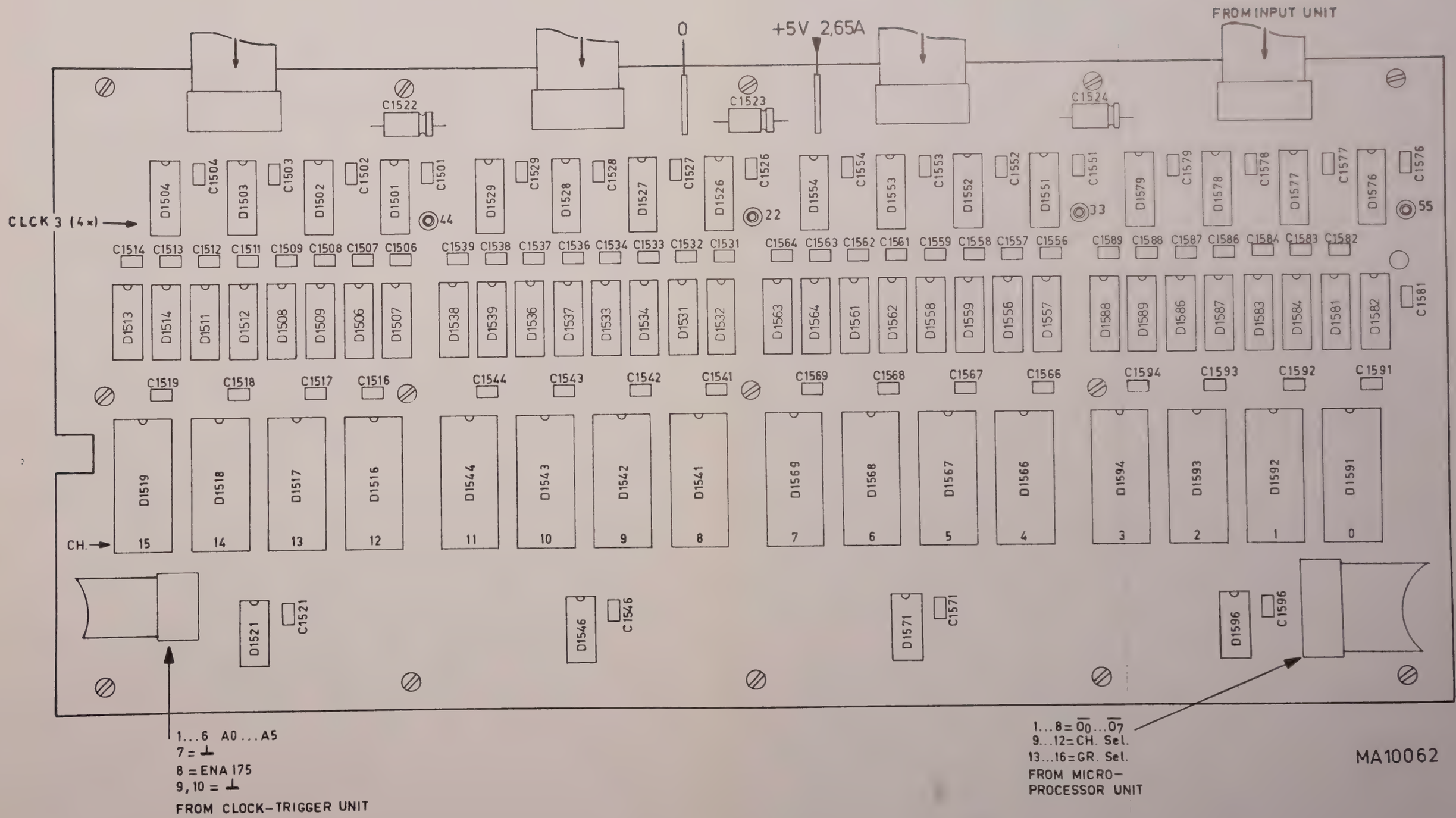
C1501----C1519 22N
C1522 68µ
C1523 68µ
C1524 68µ
C1521 22N

3-D1353 6-D1353 11-D1353 8-D1353 8-D1354

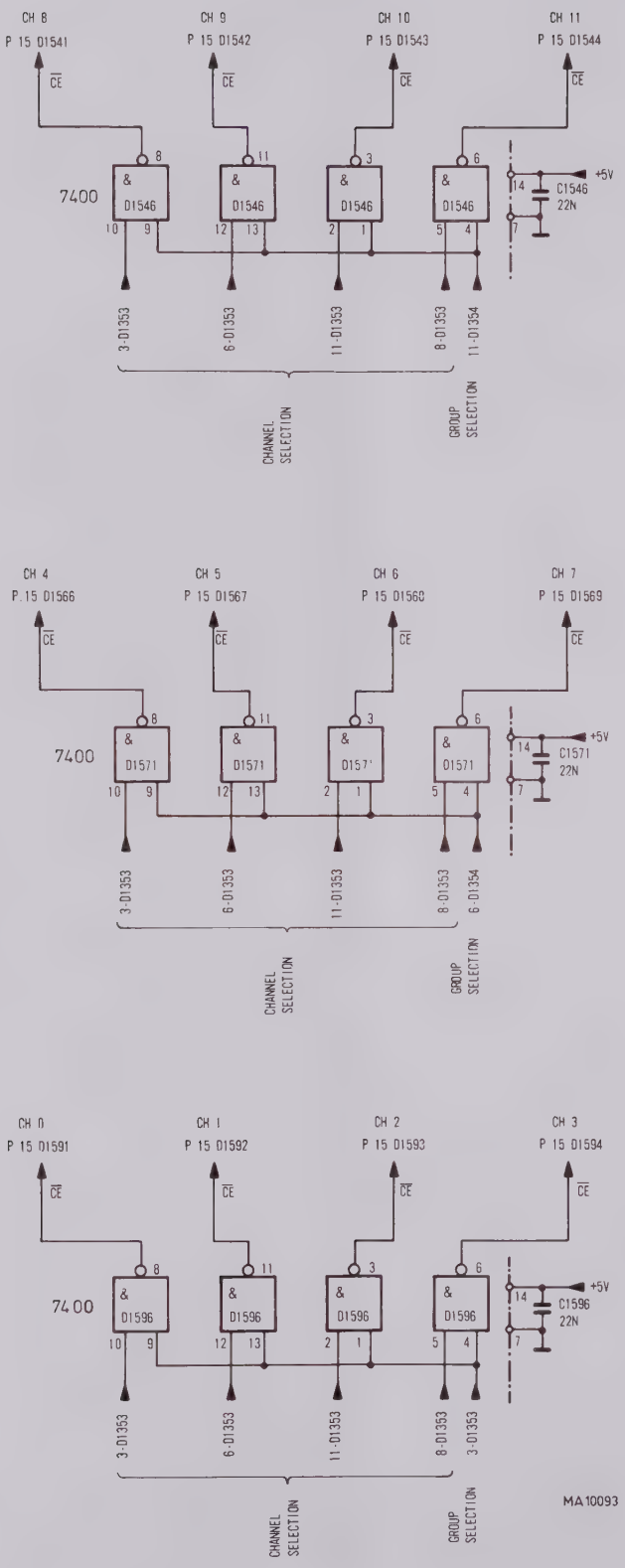
CHANNEL SELECTION GROUP SELECTION

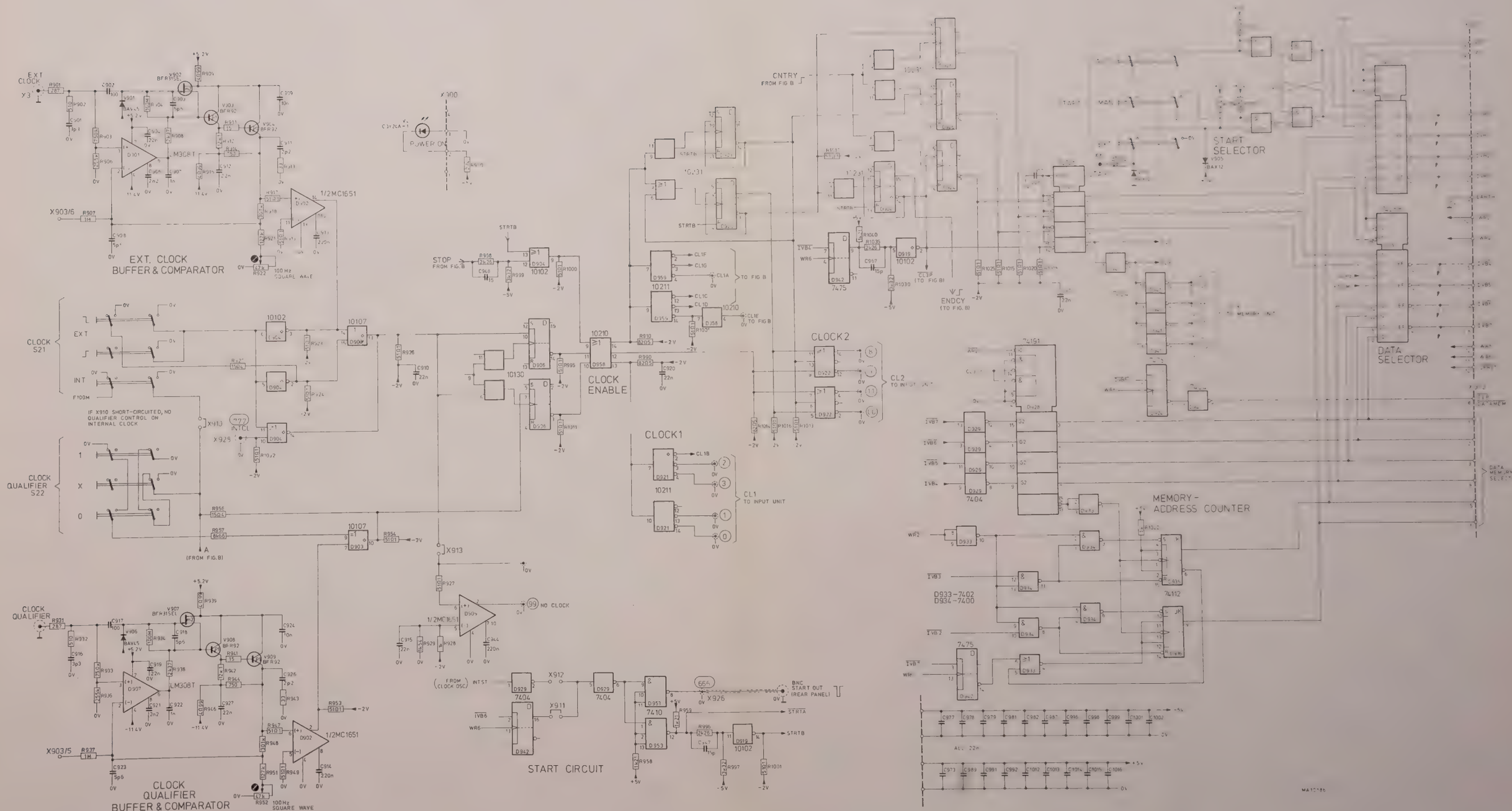
MA10068

4 *Memory circuit ch. 12 ... 15*

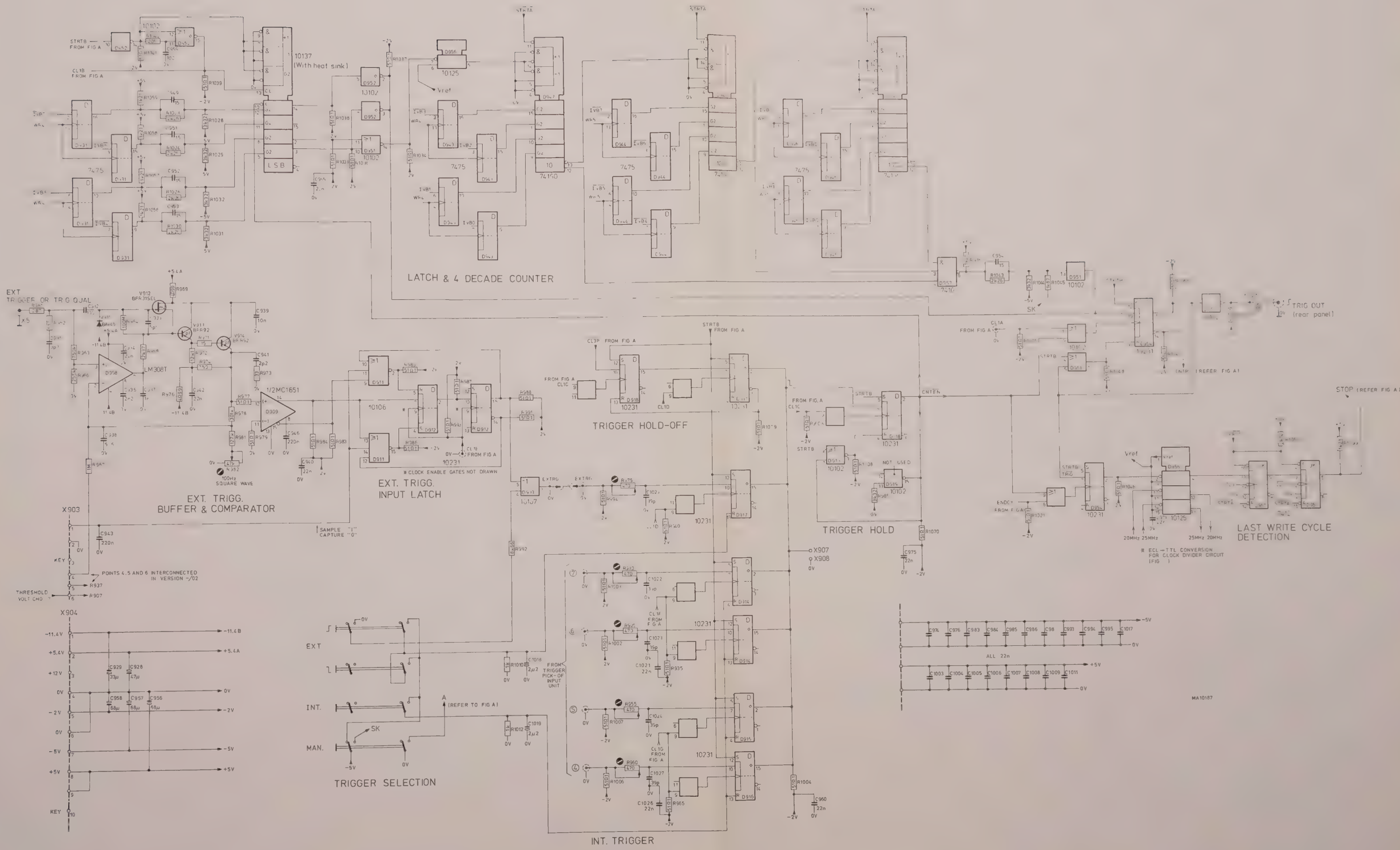

FROM INPUT UNIT
0
+5V 2,65A
C1522
C1523
C1524
CLCK 3 (4×)
D1504 C1504 D1503 C1503 D1502 C1502 D1501 C1501 44
D1529 C1529 D1528 C1528 D1527 C1527 D1526 C1526 22
D1554 C1554 D1553 C1553 D1552 C1552 D1551 C1551 33
D1579 C1579 D1578 C1578 D1577 C1577 D1576 C1576 55
C1514 C1513 C1512 C1511 C1509 C1508 C1507 C1506
C1539 C1538 C1537 C1536 C1534 C1533 C1532 C1531
C1564 C1563 C1562 C1561 C1559 C1558 C1557 C1556
C1589 C1588 C1587 C1586 C1584 C1583 C1582
D1513 D1514 D1511 D1512 D1508 D1509 D1506 D1507
D1538 D1539 D1536 D1537 D1533 D1534 D1531 D1532
D1563 D1564 D1561 D1562 D1558 D1559 D1556 D1557
D1588 D1589 D1586 D1587 D1583 D1584 D1581 D1582
C1581
C1519 C1518 C1517 C1516
C1544 C1543 C1542 C1541
C1569 C1568 C1567 C1566
C1594 C1593 C1592 C1591
D1519 D1518 D1517 D1516
D1544 D1543 D1542 D1541
D1569 D1568 D1567 D1566
D1594 D1593 D1592 D1591
CH.
15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
D1521 C1521
D1546 C1546
D1571 C1571
D1596 C1596
1...6 A0...A5
7 = ⊥
8 = ENA 175
9, 10 = ⊥
FROM CLOCK-TRIGGER UNIT
1...8 = $\overline{O_0}$...$\overline{O_7}$
9...12 = CH. Sel.
13...16 = GR. Sel.
FROM MICRO-
PROCESSOR UNIT

MA10062

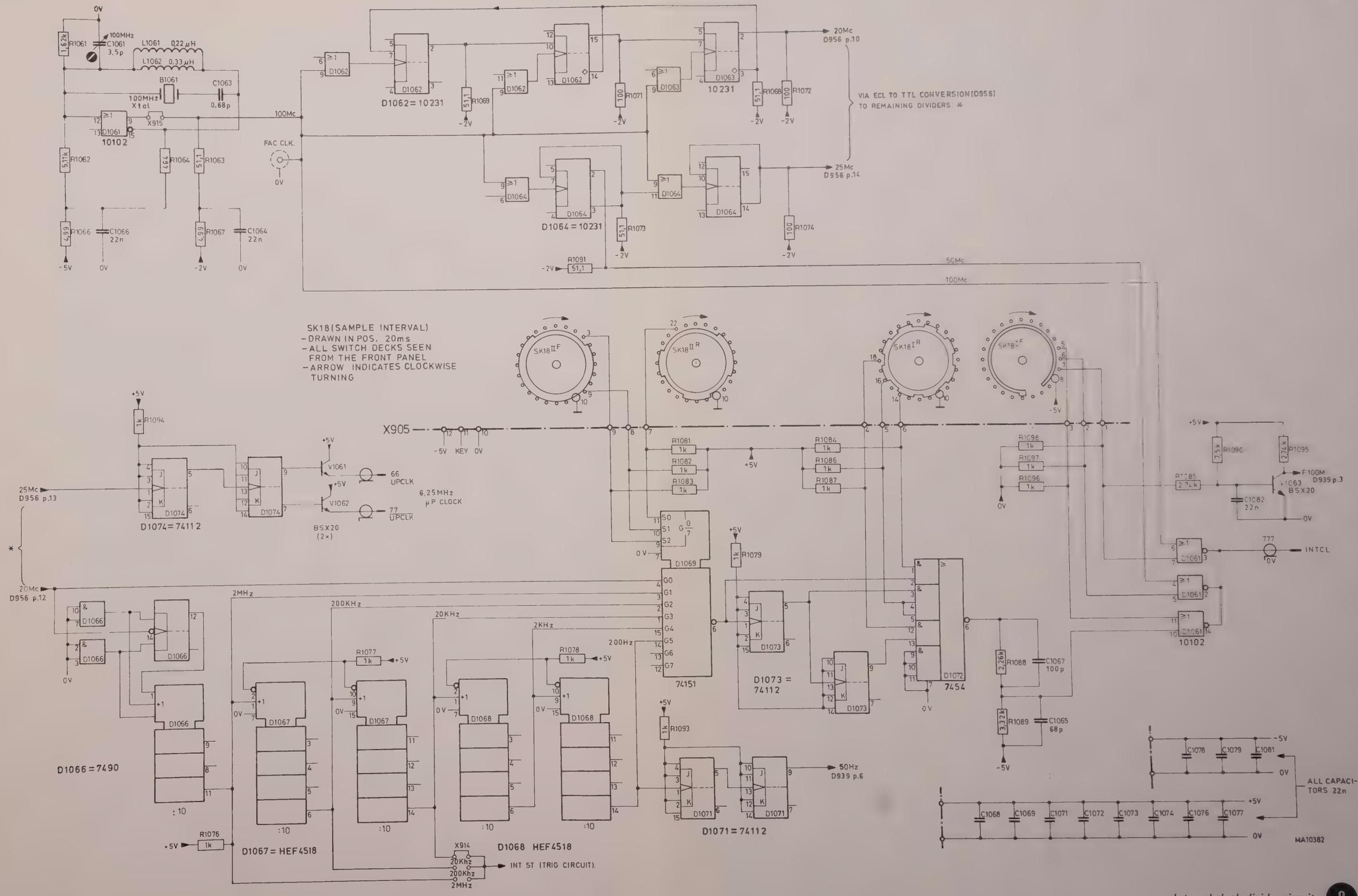

CH 8
P 15 D1541
CH 9
P 15 D1542
CH 10
P 15 D1543
CH 11
P 15 D1544
CE
7400
D1546
+5V
C1546
22N
3-D1353
6-D1353
11-D1353
8-D1353
11-D1354
CHANNEL SELECTION
GROUP SELECTION
CH 4
P 15 D1566
CH 5
P 15 D1567
CH 6
P 15 D1568
CH 7
P 15 D1569
D1571
C1571
22N
3-D1353
6-D1353
11-D1353
8-D1353
6-D1354
CHANNEL SELECTION
GROUP SELECTION
CH 0
P 15 D1591
CH 1
P 15 D1592
CH 2
P 15 D1593
CH 3
P 15 D1594
D1596
C1596
22N
3-D1353
6-D1353
11-D1353
8-D1353
3-D1353
CHANNEL SELECTION
GROUP SELECTION
MA10093

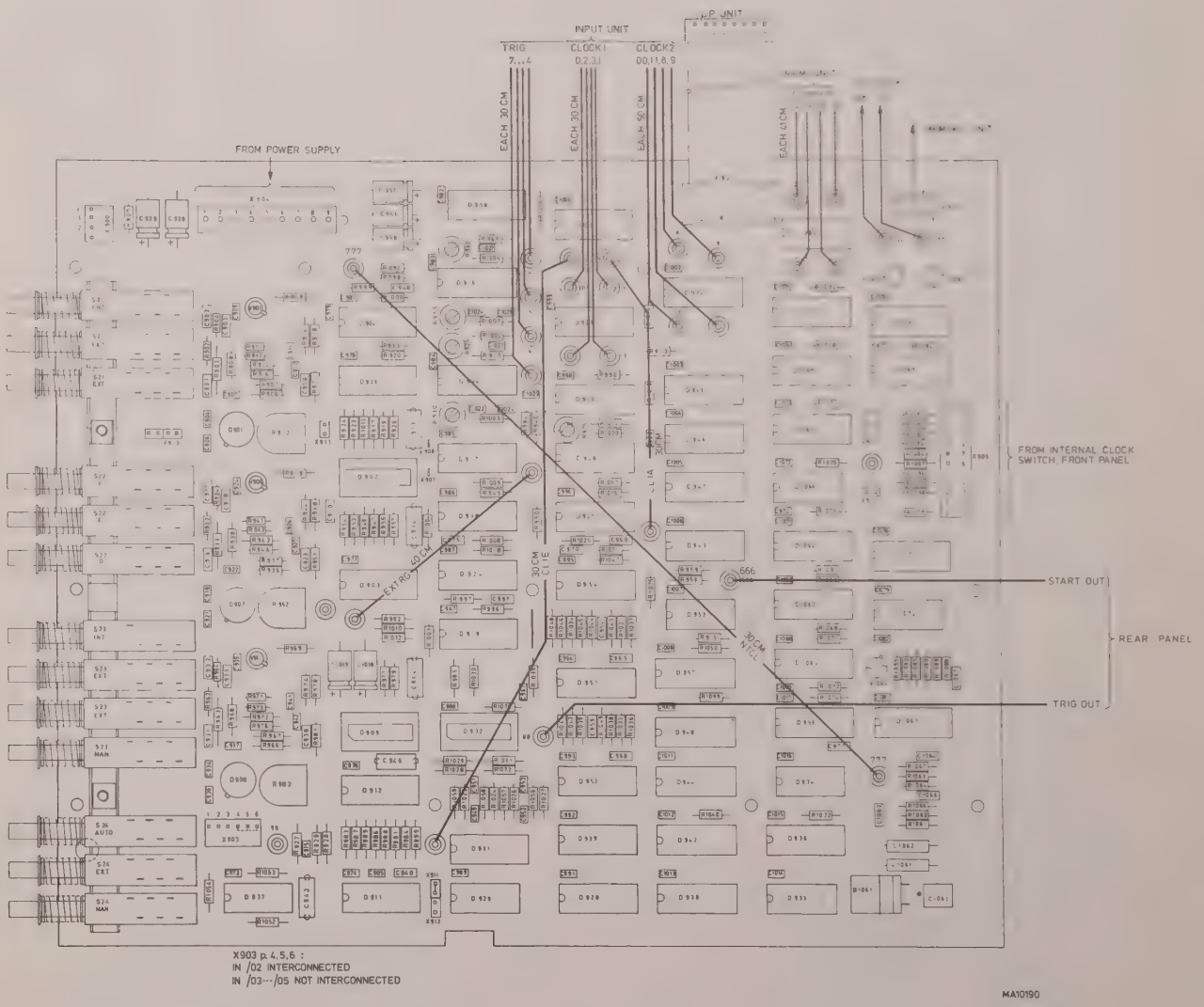


Clock distribution and memory address counter **7a**

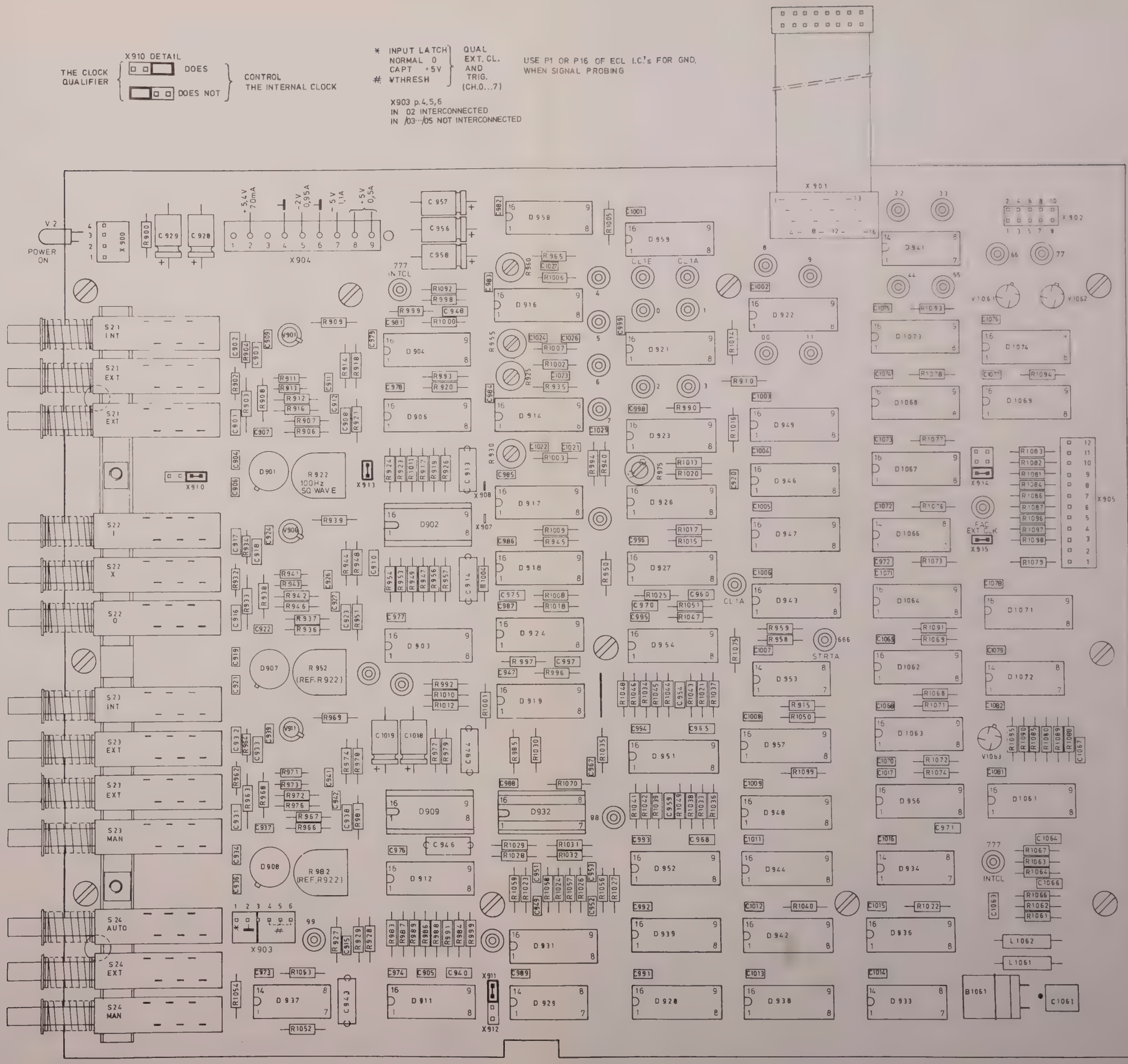

LATCH & 4 DECADE COUNTER
EXT. TRIGG. BUFFER & COMPARATOR
EXT. TRIGG. INPUT LATCH
TRIGGER HOLD-OFF
TRIGGER HOLD
LAST WRITE CYCLE DETECTION
TRIGGER SELECTION
INT. TRIGGER
TRIG OUT (rear panel)
STOP (REFER FIG A1)
SAMPLE "1" CAPTURE "0"
POINTS 4, 5 AND 6 INTERCONNECTED IN VERSION -/02
* CLOCK ENABLE GATES NOT DRAWN
* ECL—TTL CONVERSION FOR CLOCK DIVIDER CIRCUIT (FIG)
MA10187

7b *Trigger combination and delay counter*


0V
1,62k R1061
100MHz
C1061 3,5p
L1061 0,22 µH
L1062 0,33 µH
B1061
100MHz Xtal
C1063 0,68p
X915
D1061
10102
5,11k R1062
464 R1064
51,1 R1063
4,99 R1066
C1066 22n
4,99 R1067
C1064 22n
-5V
0V
-2V
100Mc
FAC CLK.
D1062
D1062=10231
51,1 R1069
100 R1071
D1063
10231
51,1 R1068
100 R1072
20Mc D956 p.10
VIA ECL TO TTL CONVERSION(D956)
TO REMAINING DIVIDERS: *
D1064
D1064 = 10231
51,1 R1073
100 R1074
25Mc D956 p.14
R1091 51,1
50Mc
100Mc
SK18(SAMPLE INTERVAL)
-DRAWN IN POS. 20ms
-ALL SWITCH DECKS SEEN FROM THE FRONT PANEL
-ARROW INDICATES CLOCKWISE TURNING
SK18 II F
SK18 II R
SK18 I R
SK18 I F
X905
-5V KEY 0V
+5V
1k R1094
25Mc D956 p.13
D1074
D1074=74112
V1061
V1062
BSX20 (2×)
66 UPCLK
77 UPCLK
6,25MHz µP CLOCK
R1081 1k
R1082 1k
R1083 1k
R1084 1k
R1086 1k
R1087 1k
R1098 1k
R1097 1k
R1096 1k
7,5k R1090
274k R1095
F100M D939 p.3
V1063 BSX20
C1082 22n
777
INTCL
20Mc D956 p.12
D1066
D1066=7490
2MHz
200KHz
20KHz
2KHz
200Hz
R1077 1k
R1078 1k
D1067
D1067=HEF4518
D1068 HEF4518
R1076 1k
X914
20Khz
200Khz
2MHz
INT ST (TRIG CIRCUIT).
D1069
74151
R1079 1k
D1073
D1073 = 74112
D1072
7454
R1093 1k
D1071
D1071=74112
50Hz D939 p.6
2,26k R1088
C1067 100p
3,32k R1089
C1065 68p
C1078
C1079
C1081
C1068
C1069
C1071
C1072
C1073
C1074
C1076
C1077
ALL CAPACITORS 22n
MA10382



9a *Cable connections clock and trigger unit*


X910 DETAIL
THE CLOCK QUALIFIER
DOES
DOES NOT
CONTROL THE INTERNAL CLOCK
* INPUT LATCH NORMAL 0 CAPT +5V
# VTHRESH
QUAL EXT. CL. AND TRIG. (CH.0...7)
USE P1 OR P16 OF ECL I.C.'s FOR GND. WHEN SIGNAL PROBING
X903 p.4,5,6
IN 02 INTERCONNECTED
IN /03···/05 NOT INTERCONNECTED
DETAIL X914
– 20kHz
– 200kHz
– 2MHz
X901
X902
X903
X904
X905
X906
X907
X908
X910
X911
X912
X913
X914
X915
S21 INT
S21 EXT
S21 EXT
S22 I
S22 X
S22 O
S23 INT
S23 EXT
S23 EXT
S23 MAN
S24 AUTO
S24 EXT
S24 MAN
D901
R922 100Hz SQ WAVE
D907
R952 (REF.R922)
D908
R982 (REF.R922)
D902
D903
D904
D906
D909
D911
D912
D916
D917
D918
D919
D924
D926
D927
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D934
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C1080
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C1092
C1093
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C1095
C1096
C1097
C1098
C1099
L1061
L1062
B1061
V1061
V1062
V1063
R1001
R1002
R1003
R1004
R1005
R1006
R1007
R1008
R1009
R1010
R1011
R1012
R1013
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R1015
R1016
R1017
R1018
R1020
R1021
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R960
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R975
R930
R994
R940
R950
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R910
R920
R935
R945
R970
R980
R990
R995
R996
R997
R999
R1000
R1014
R1016
R1017
R1018
R1019
R1020
R1021
R1022
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R1024
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R1080
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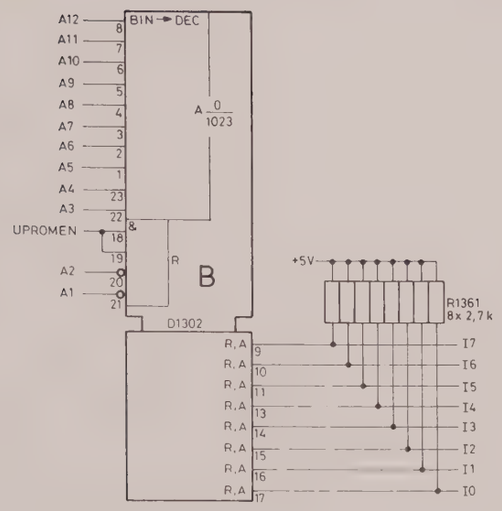
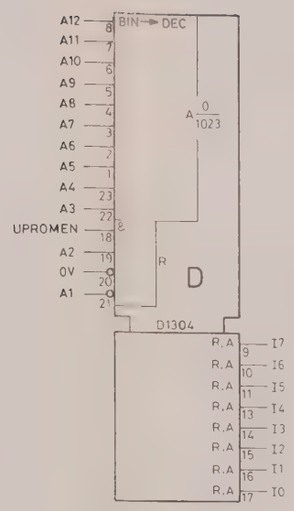
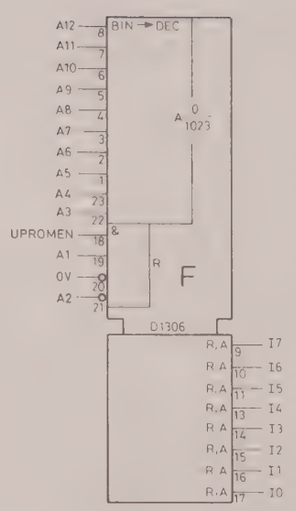
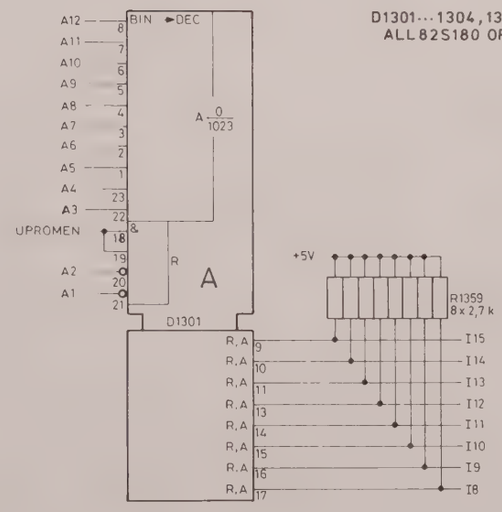
R1088
R1089
R1090
R1091
R1092
R1093
R1094
R1095
R1096
R1097
R1098
R1099
+5,4V 70mA
-2V 0,95A
-5V 1,1A
+5V 0,5A
V2
POWER ON
X900
R900
777 INTCL
666 STRTA
CL 1A
CL 1E

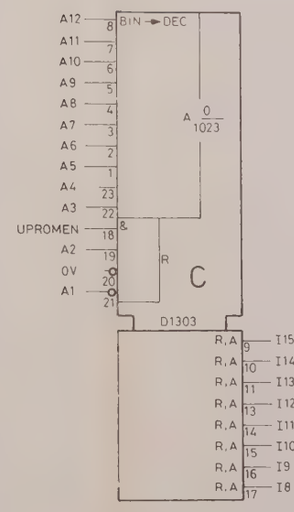
MA10189

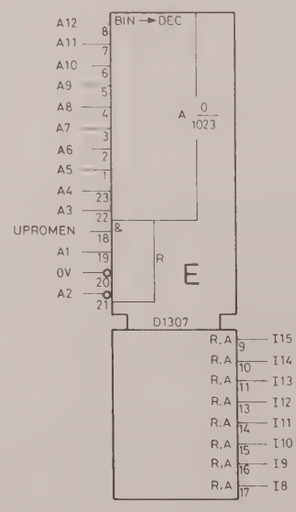






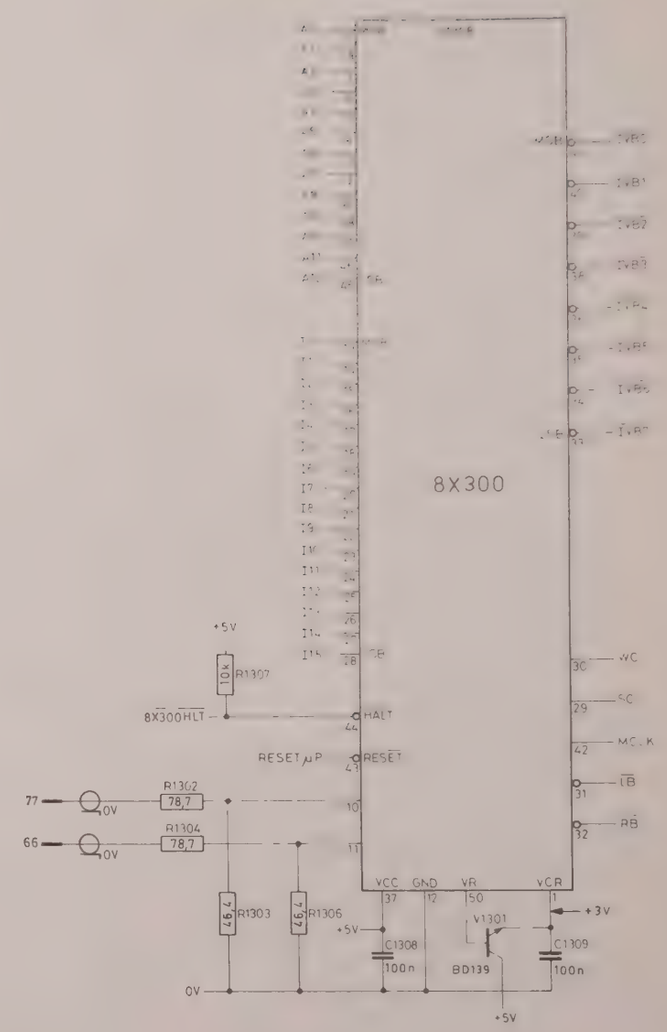




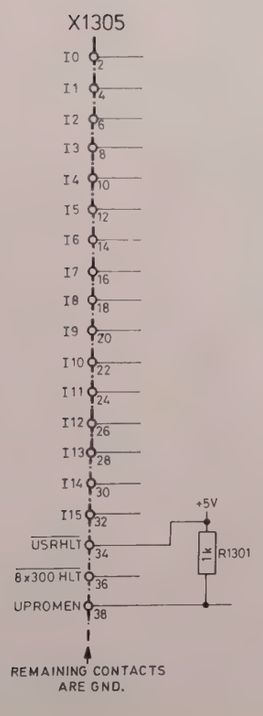


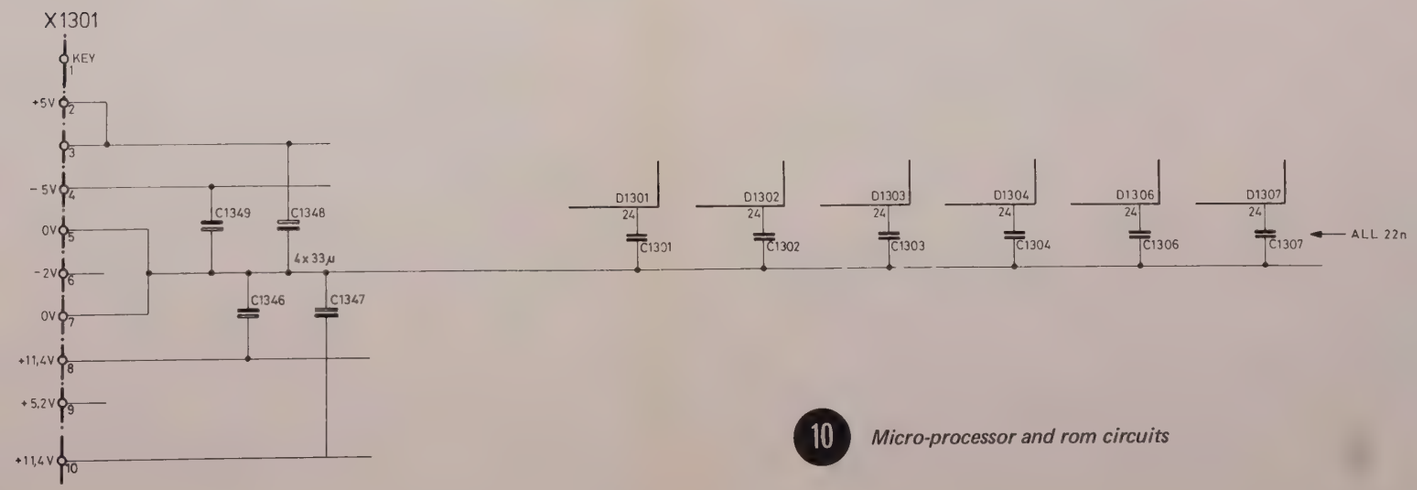
D1301···1304, 1306, 1307
ALL 82S180 OR 82S181

PROM'S

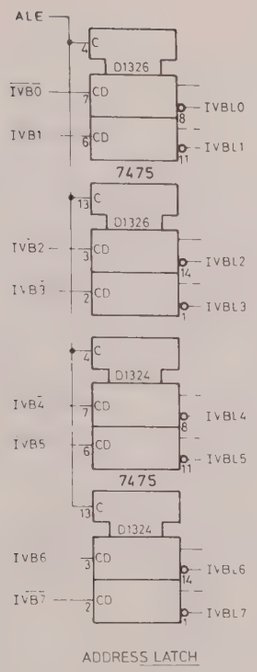


µP

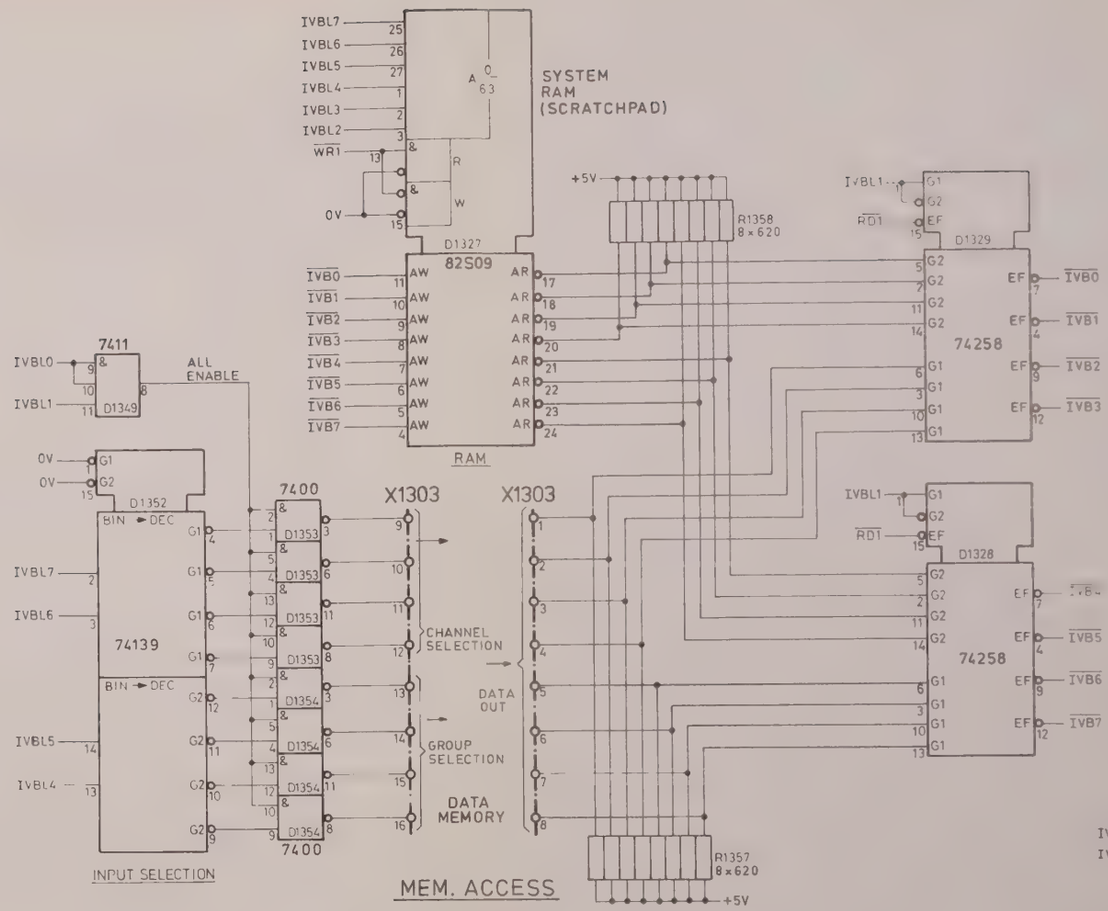




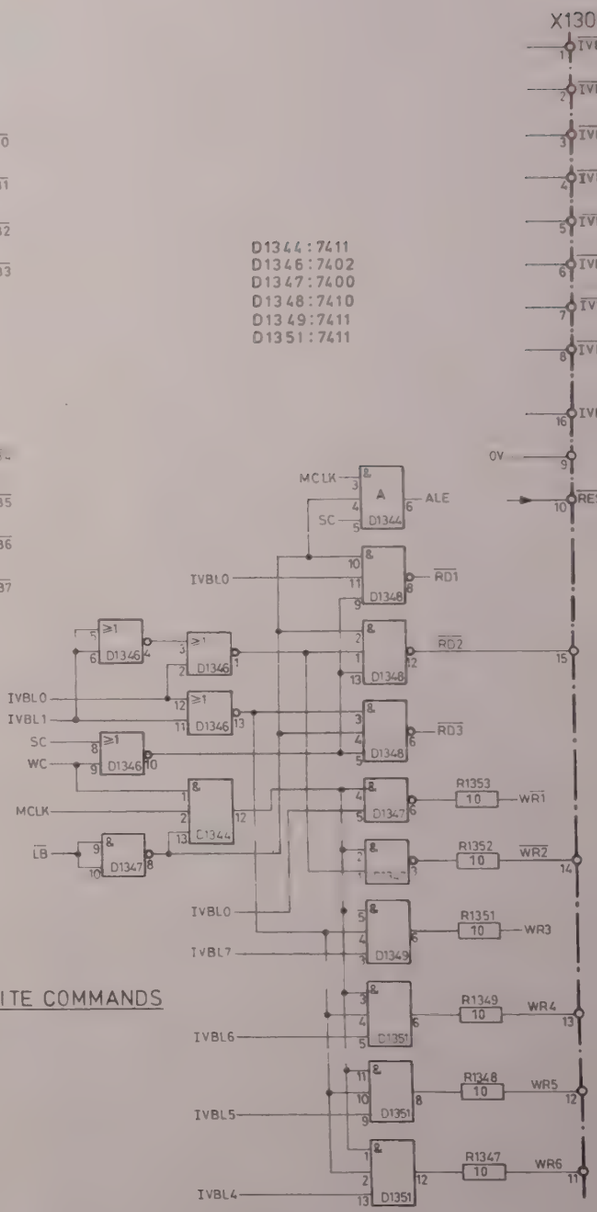
MA 10101



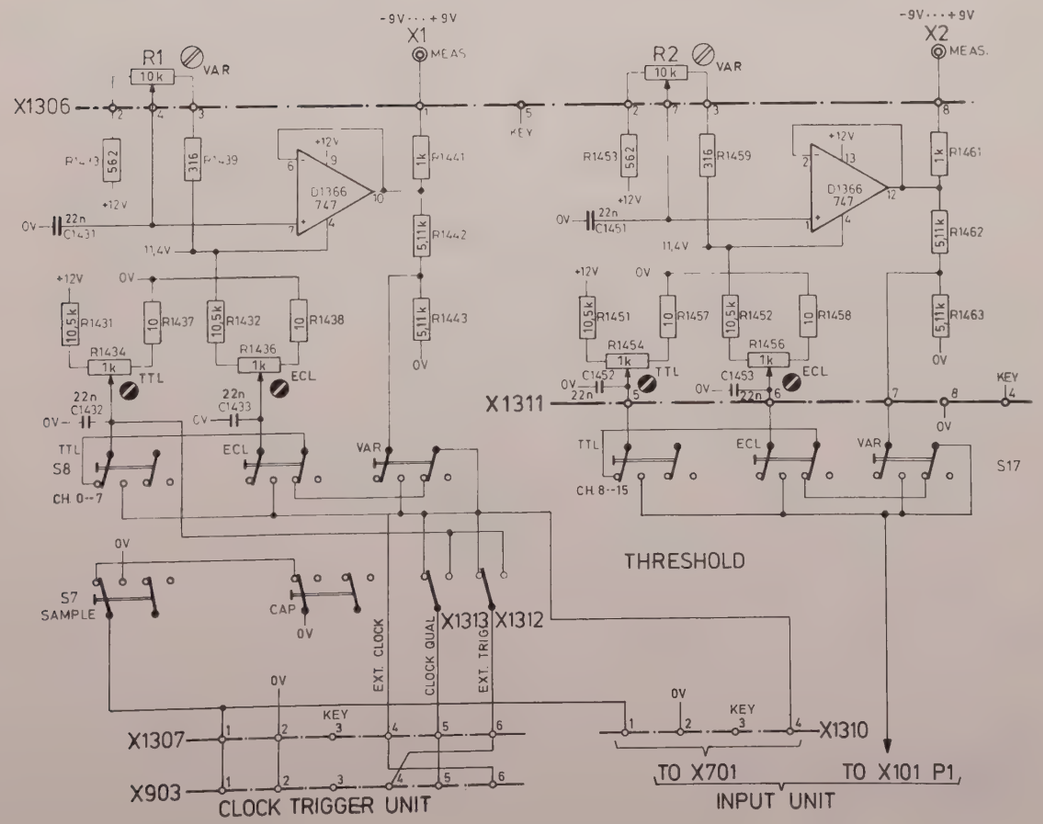
ADDRESS LATCH

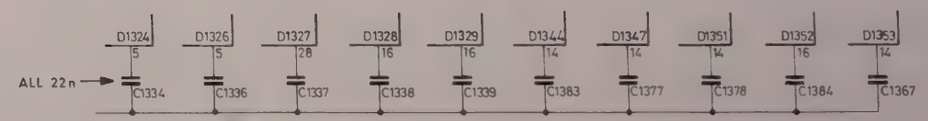


D1344 : 7411
D1346 : 7402
D1347 : 7400
D1348 : 7410
D1349 : 7411
D1351 : 7411

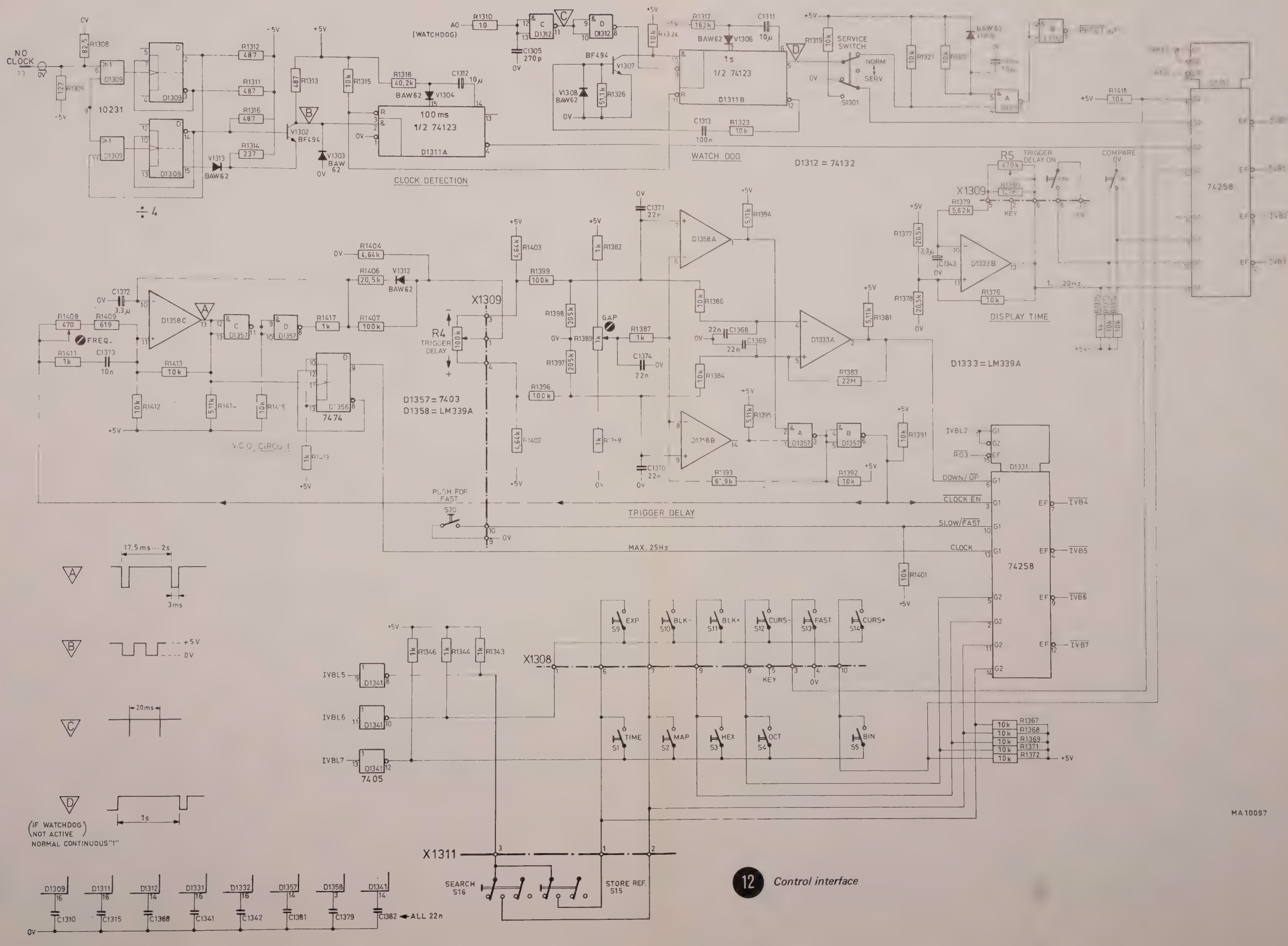


READ & WRITE COMMANDS

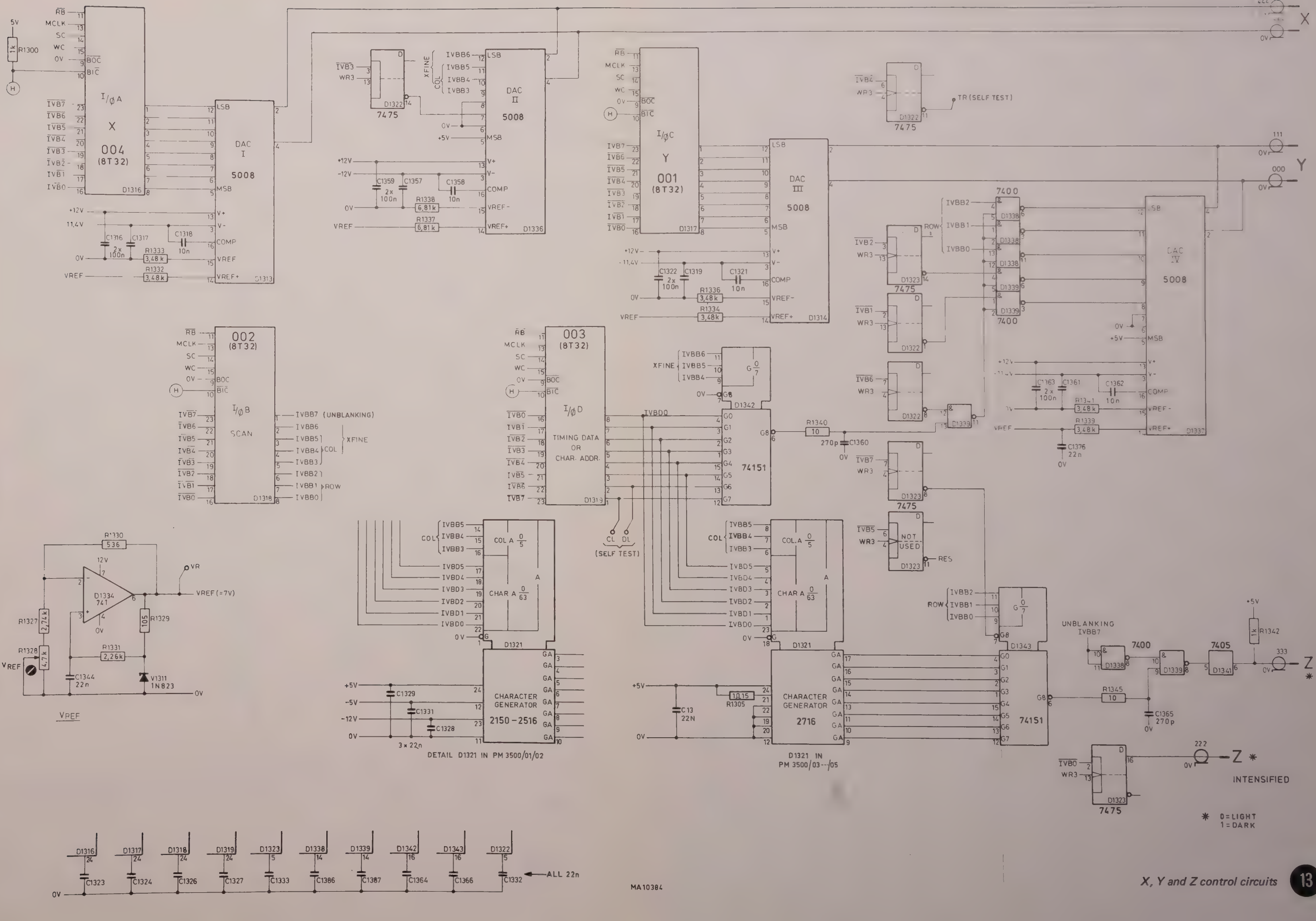


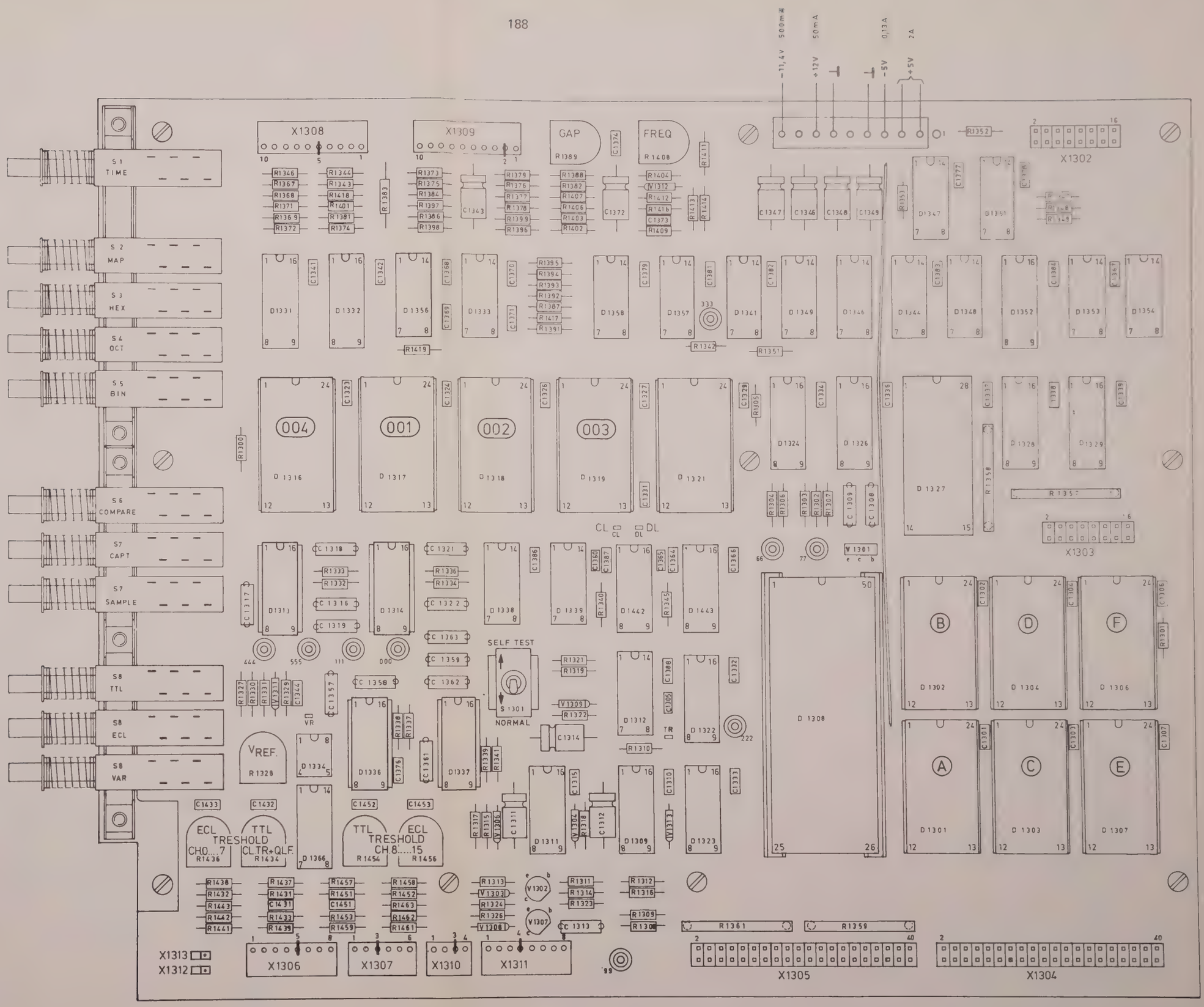


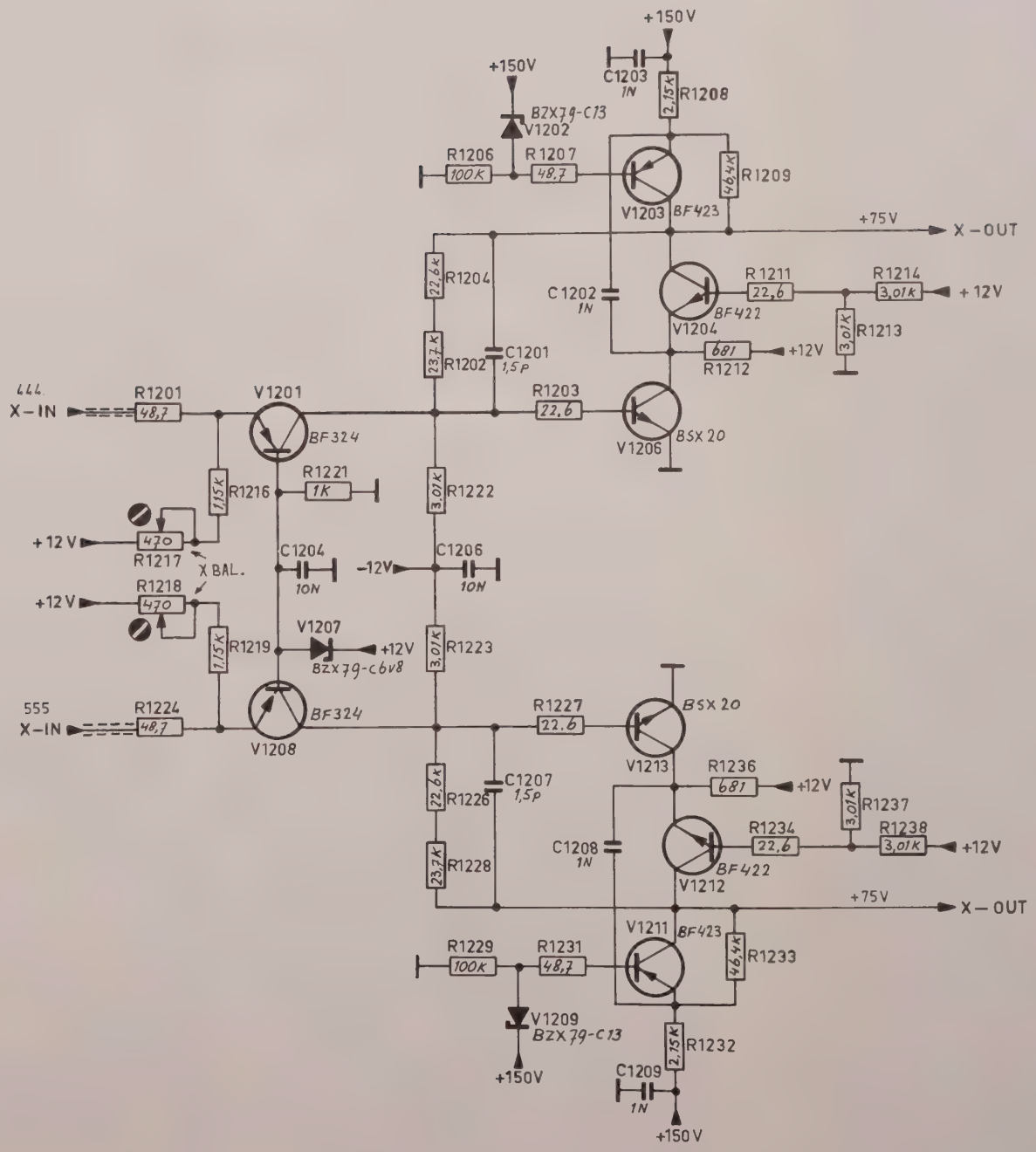
MA10385

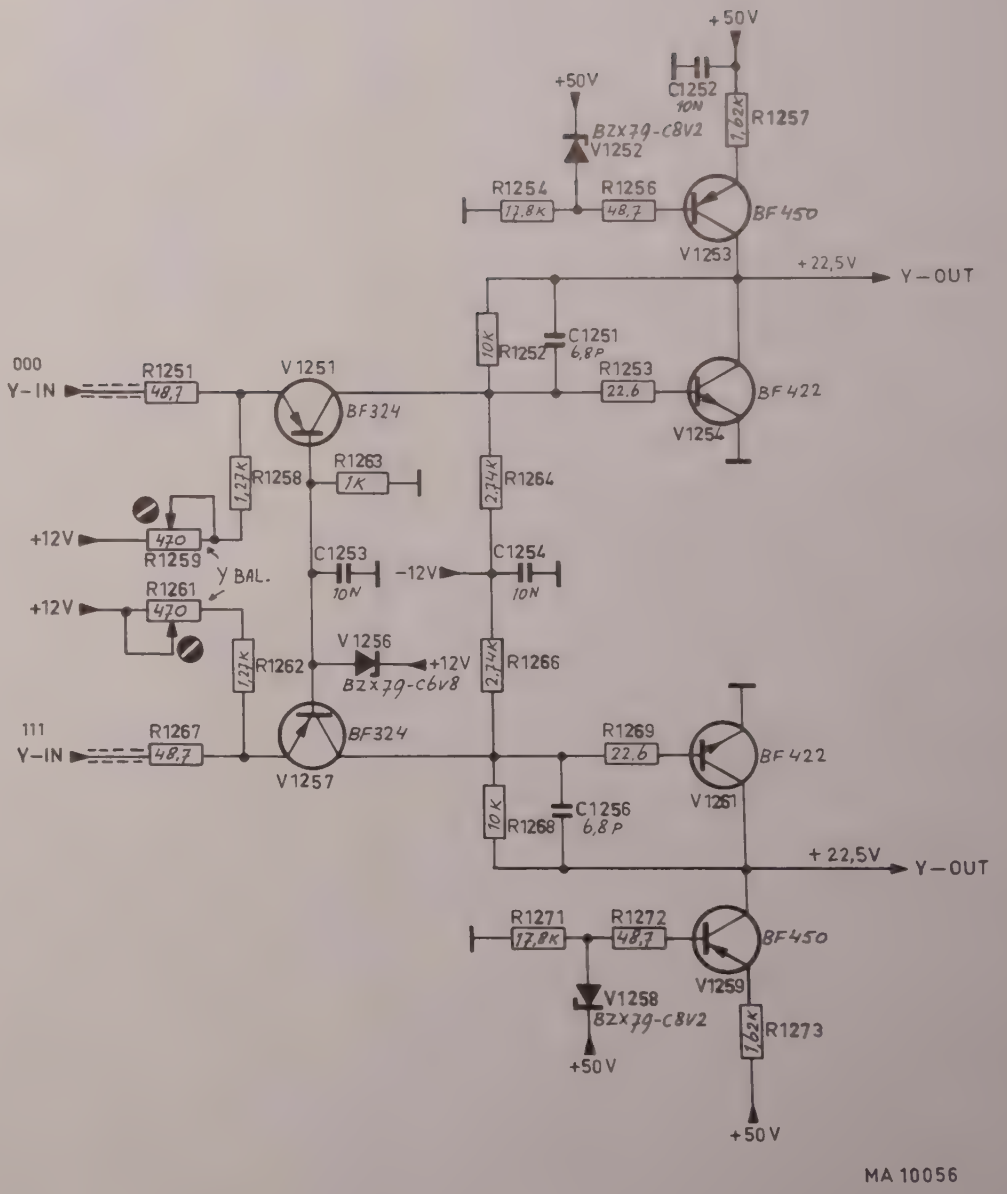


12 *Control interface*

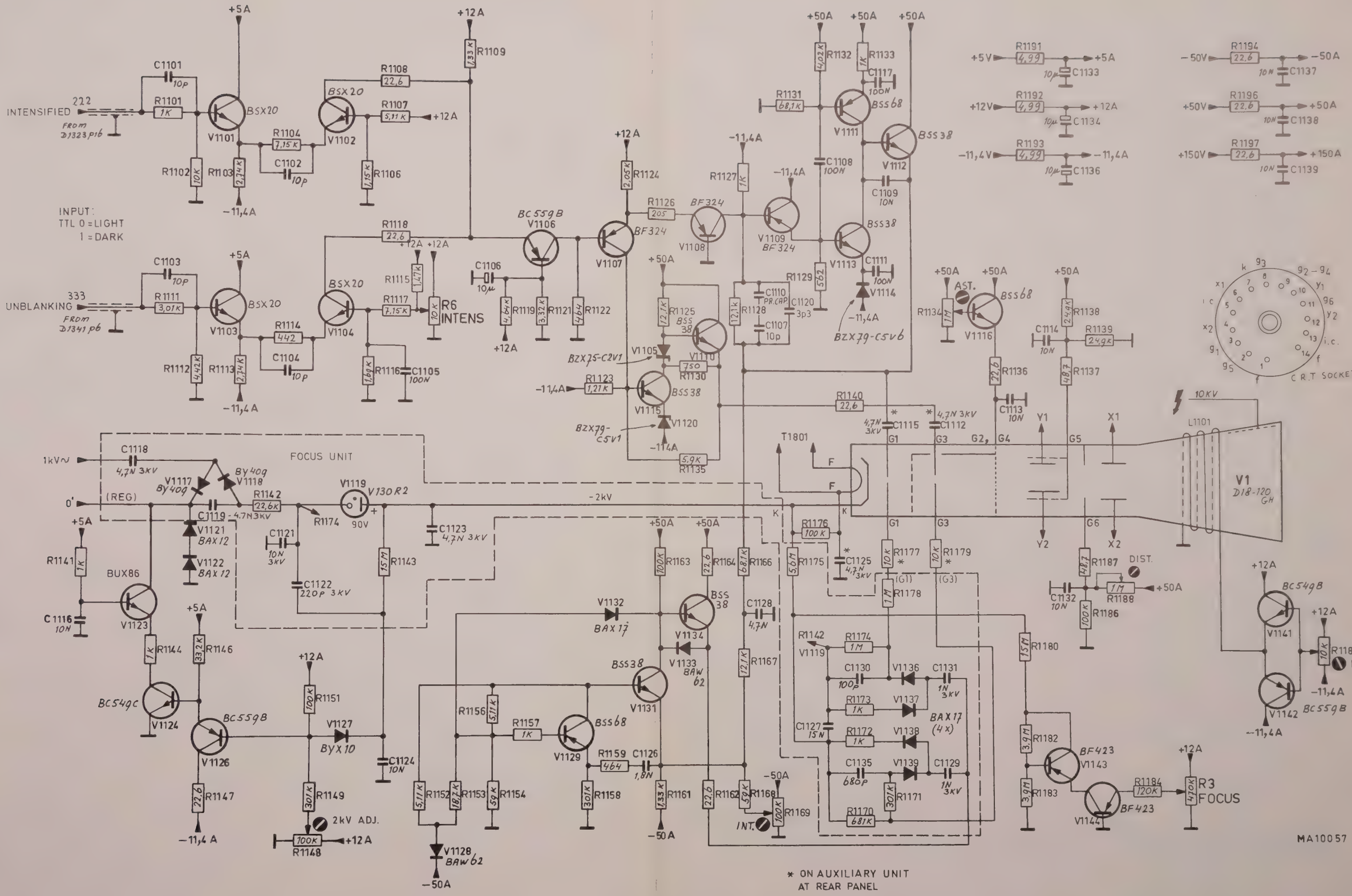

X
Y
Z *
TR (SELF TEST)
DAC I 5008
DAC II 5008
DAC III 5008
DAC IV 5008
I/ØA X 004 (8T32)
I/ØB SCAN
I/ØC Y 001 (8T32)
I/ØD TIMING DATA OR CHAR. ADDR.
002 (8T32)
003 (8T32)
7475
7400
7405
74151
CHARACTER GENERATOR 2150-2516
CHARACTER GENERATOR 2716
IVBB7 (UNBLANKING)
XFINE
ROW
COL
UNBLANKING IVBB7
NOT USED
RES
CL DL (SELF TEST)
VREF (=7V)
VREF
V1311 1N823
D1334 741
DETAIL D1321 IN PM 3500/01/02
D1321 IN PM 3500/03---/05
* 0 = LIGHT 1 = DARK
INTENSIFIED
ALL 22n
MA10384


-11,4 V 500mA
+12V 50mA
-5V 0,1A
+5V 2A
X1308
X1309
GAP
R1389
FREQ
R1408
X1302
X1303
S1 TIME
S2 MAP
S3 HEX
S4 OCT
S5 BIN
S6 COMPARE
S7 CAPT
S7 SAMPLE
S8 TTL
S8 ECL
S8 VAR
004
001
002
003
D1316
D1317
D1318
D1319
D1321
SELF TEST
S1301
NORMAL
VREF.
R1328
ECL TRESHOLD CH0....7
R1436
TTL TRESHOLD CL.TR+QLF.
R1434
TTL TRESHOLD CH.8.....15
R1454
ECL TRESHOLD CH.8.....15
R1456
D1308
D1301
D1302
D1303
D1304
D1306
D1307
X1313
X1312
X1306
X1307
X1310
X1311
X1305
X1304
MA10383

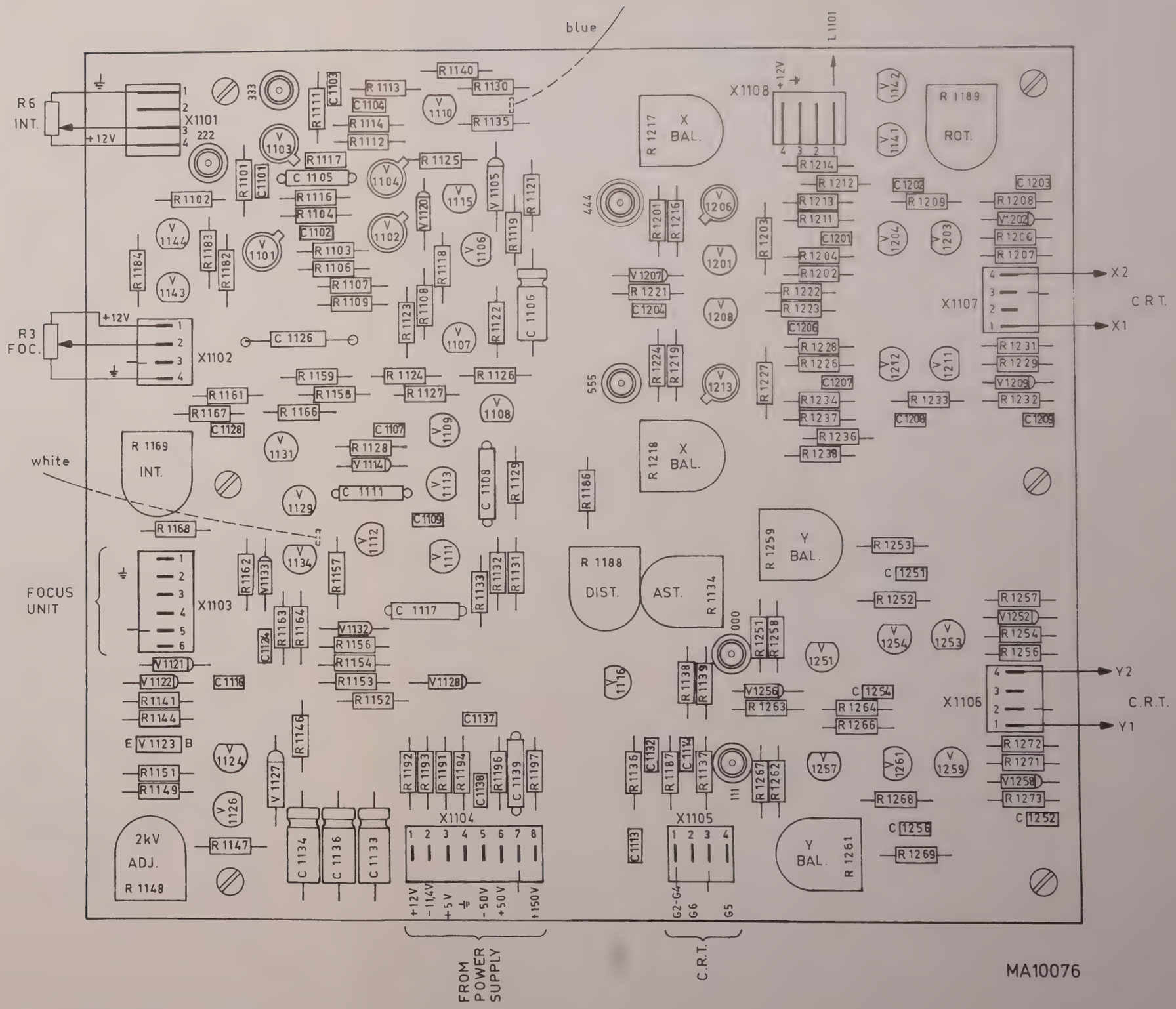

+150V
C1203
1N
R1208
2,15K
BZX79-C13
V1202
R1206
100K
R1207
48,7
46,4K
R1209
V1203
BF423
+75V
X-OUT
22,6K
R1204
C1202
1N
R1211
22,6
R1214
3,01K
+12V
BF422
V1204
681
R1212
+12V
3,01K
R1213
23,7K
R1202
C1201
1,5P
R1203
22,6
V1206
BSX20
444
X-IN
R1201
48,7
V1201
BF324
1,15K
R1216
R1221
1K
3,01K
R1222
+12V
470
R1217
X BAL.
C1204
10N
-12V
C1206
10N
R1218
470
+12V
1,15K
R1219
V1207
BZX79-C6V8
+12V
3,01K
R1223
555
X-IN
R1224
48,7
V1208
BF324
R1227
22,6
BSX20
V1213
22,6K
R1226
C1207
1,5P
R1236
681
+12V
3,01K
R1237
C1208
1N
R1234
22,6
R1238
3,01K
+12V
BF422
V1212
23,7K
R1228
+75V
X-OUT
V1211
BF423
R1229
100K
R1231
48,7
46,4K
R1233
V1209
BZX79-C13
+150V
2,15K
R1232
C1209
1N
+150V

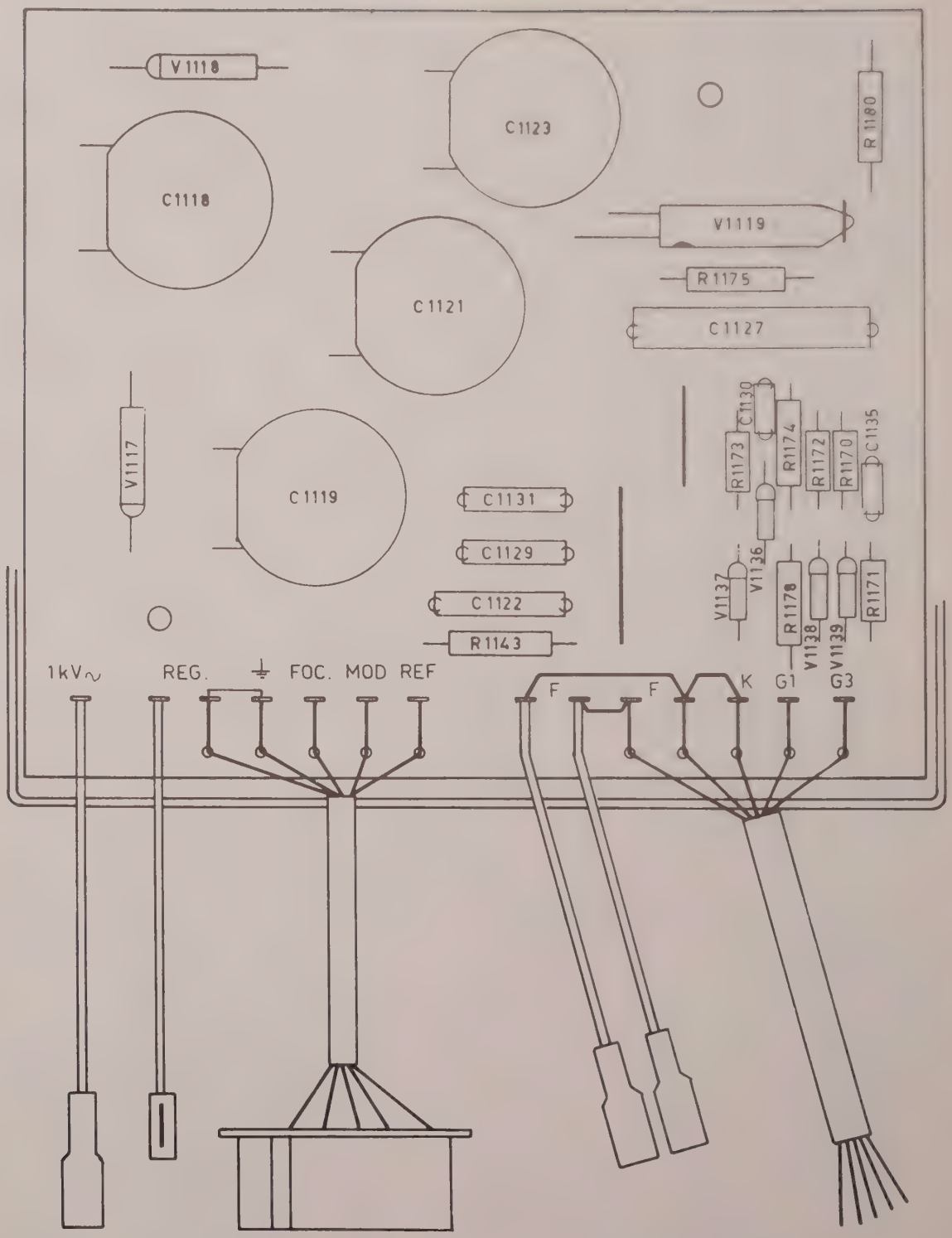

+50V
C1252
10N
R1257
1,62K
+50V
BZX79-C8V2
V1252
R1254
12,8K
R1256
48,7
BF450
V1253
+22,5V
Y-OUT
000
Y-IN
R1251
48,7
V1251
BF324
10K
R1252
C1251
6,8P
R1253
22,6
BF422
V1254
1,27K
R1258
R1263
1K
2,74K
R1264
+12V
470
R1259
Y BAL.
C1253
10N
-12V
C1254
10N
R1261
470
+12V
V1256
BZX79-C6V8
+12V
1,27K
R1262
2,74K
R1266
111
Y-IN
R1267
48,7
V1257
BF324
R1269
22,6
BF422
V1261
10K
R1268
C1256
6,8P
+22,5V
Y-OUT
R1271
12,8K
R1272
48,7
BF450
V1259
V1258
BZX79-C8V2
+50V
1,62K
R1273
+50V

MA 10056

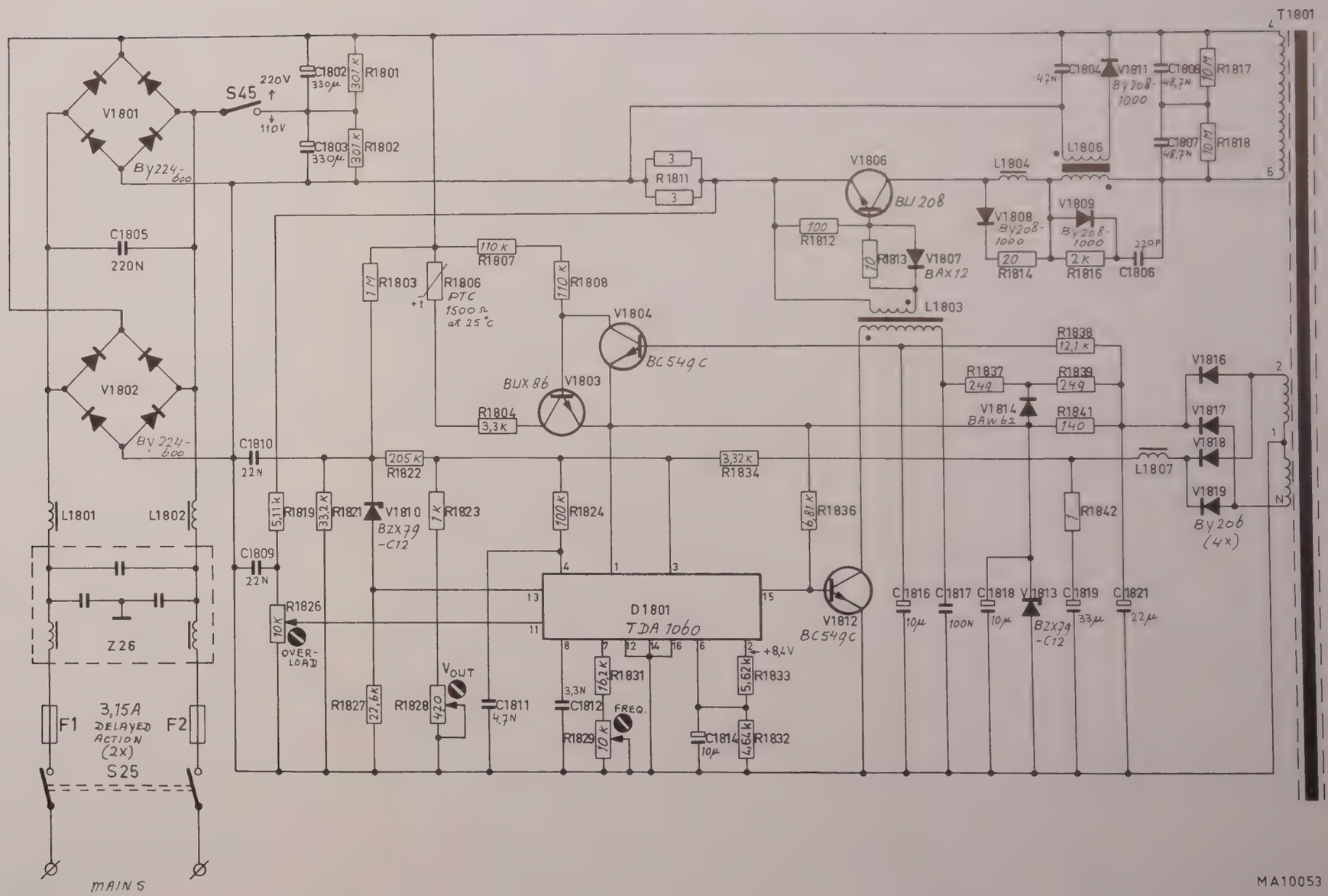


* ON AUXILIARY UNIT AT REAR PANEL

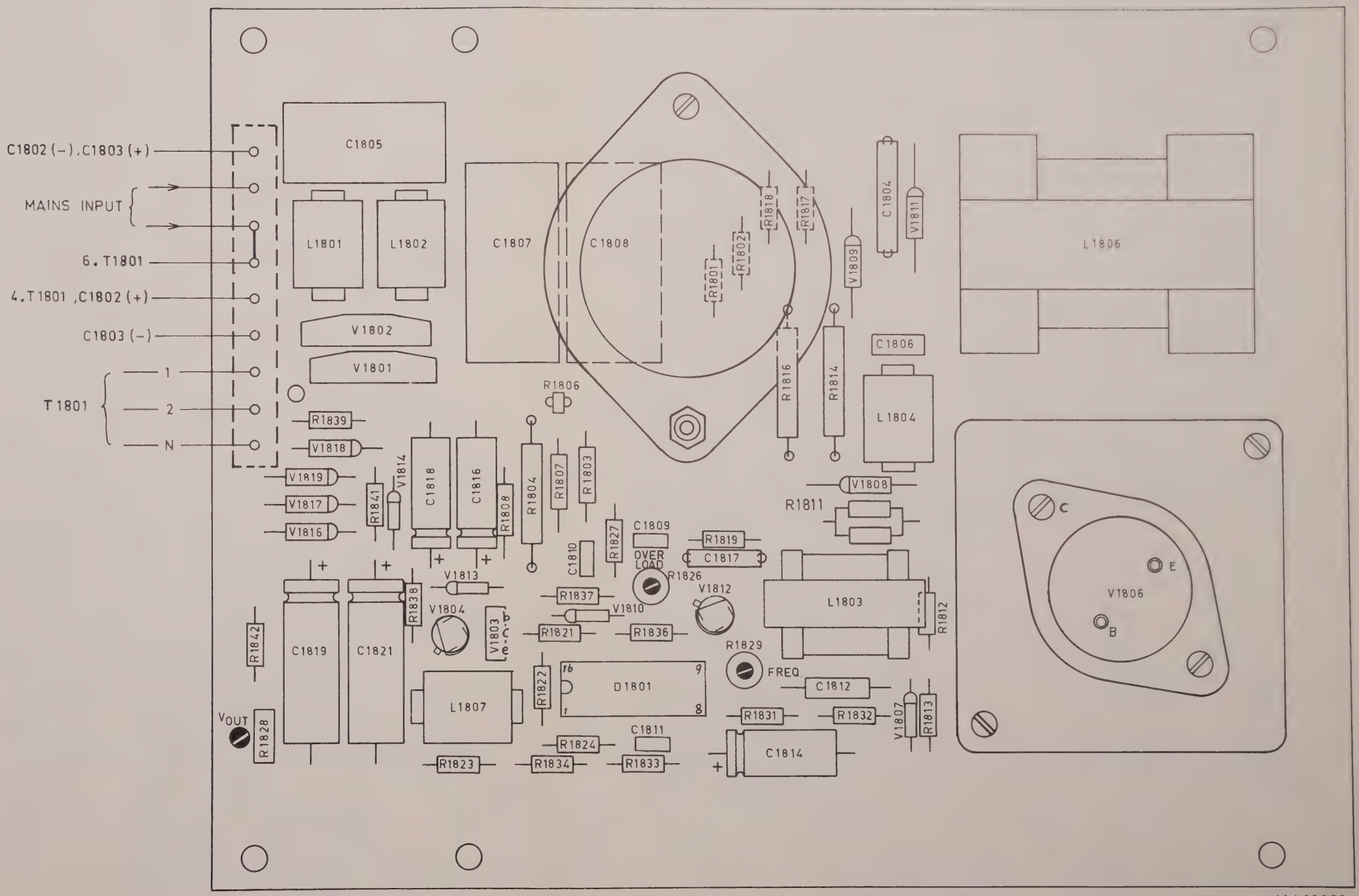

blue
white
R6 INT.
R3 FOC.
FOCUS UNIT
X1101
X1102
X1103
X1104
X1105
X1106
X1107
X1108
+12V
222
333
444
555
000
111
R 1169 INT.
R 1148 2kV ADJ.
R 1217 X BAL.
R 1218 X BAL.
R 1259 Y BAL.
R 1261 Y BAL.
R 1189 ROT.
R 1188 DIST.
R 1134 AST.
L1101
X2
X1
Y2
Y1
C.R.T.
E V1123 B
+12V
-11,4V
+5V
-50V
+50V
+150V
G2-G4
G6
G5
FROM POWER SUPPLY
C.R.T.
MA10076


V1118
C1123
R1180
C1118
V1119
R1175
C1121
C1127
C1130
V1117
R1173
R1174
R1172
R1170
C1135
C1119
C1131
C1129
V1136
V1137
R1178
R1171
C1122
V1138
V1139
R1143
1kV~
REG.
FOC. MOD REF
F
F
K
G1
G3

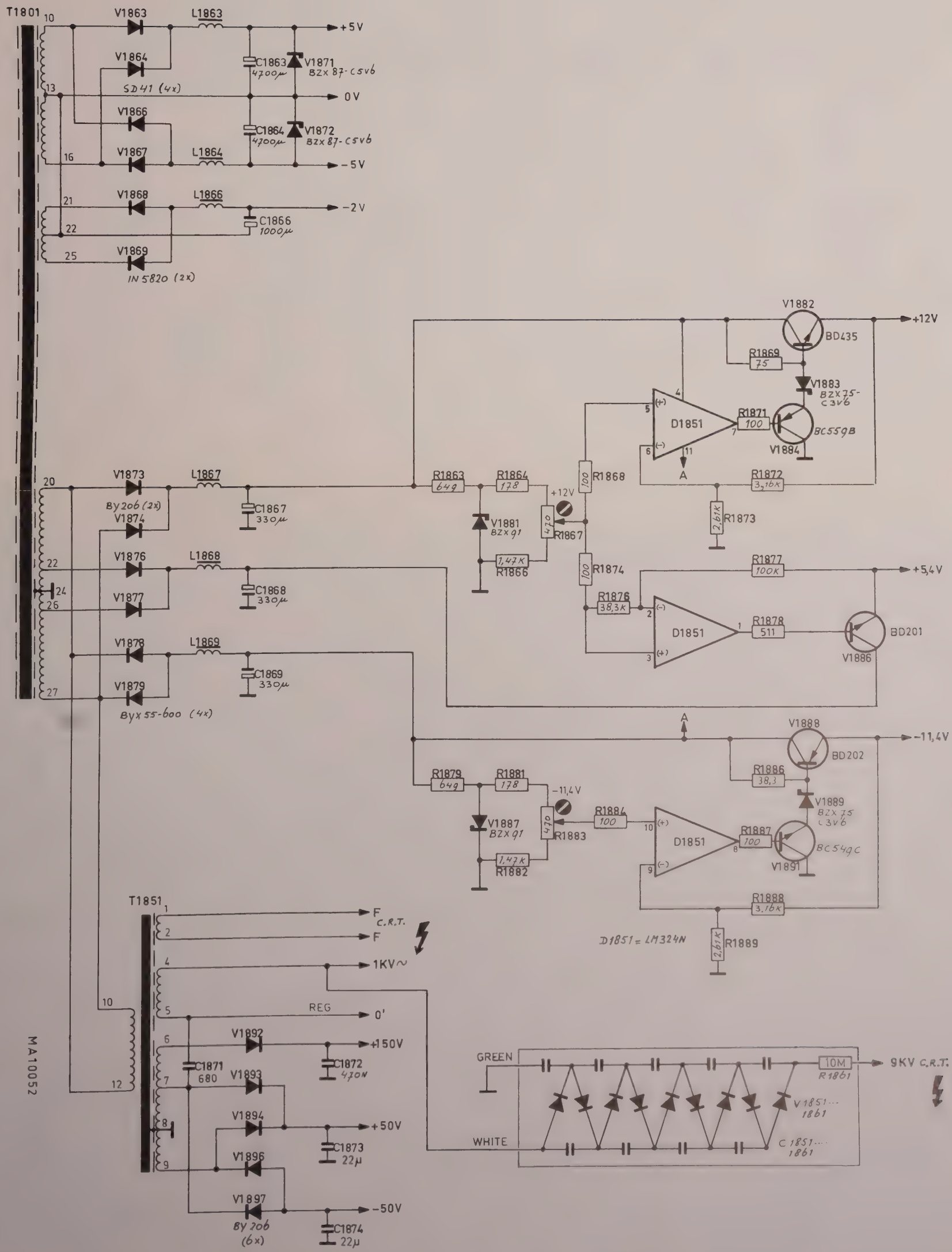
MA10074

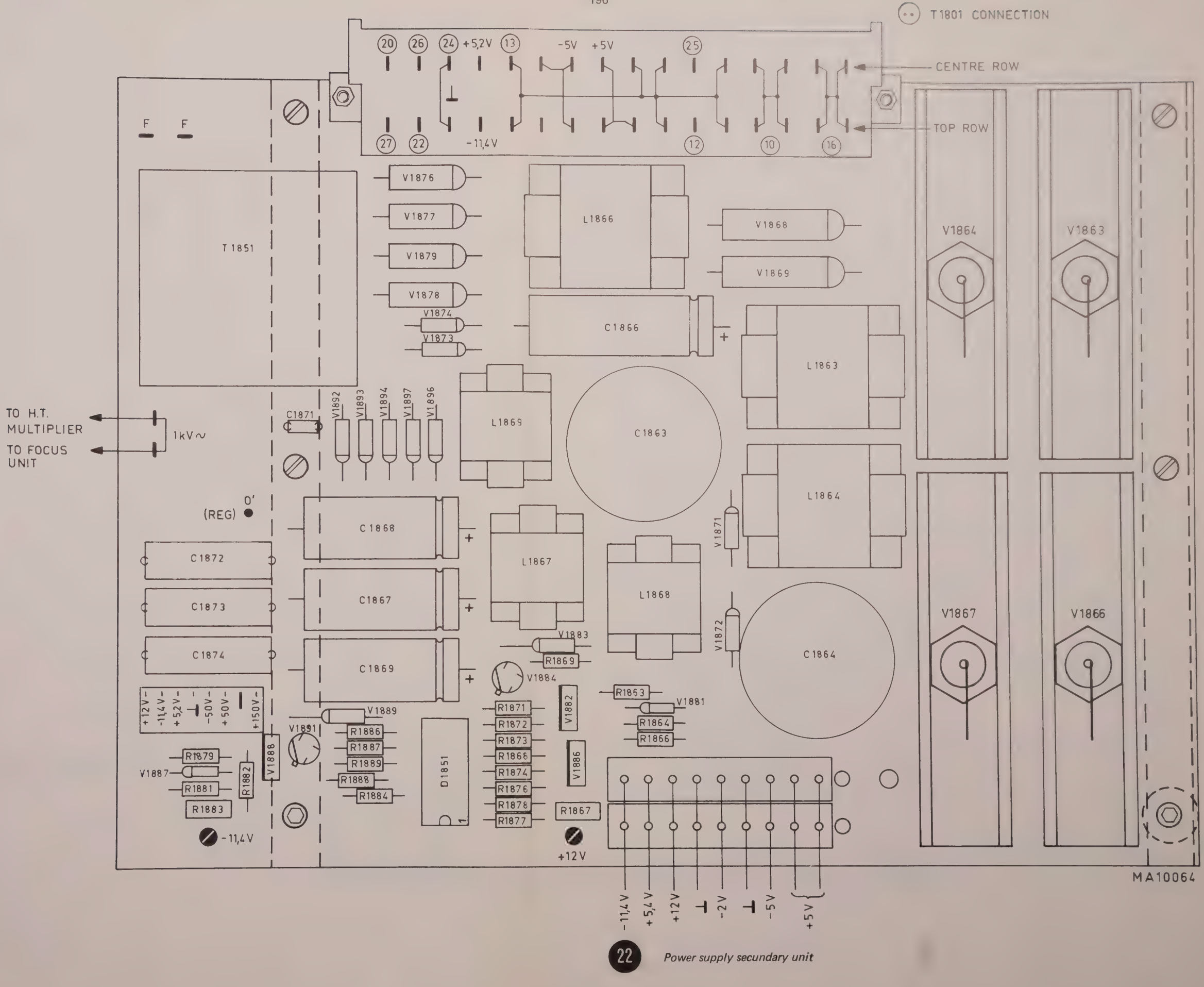

T1801
V1801
By224-600
S45
220V
110V
C1802 330µ
R1801 301K
C1803 330µ
R1802 301K
C1805 220N
V1802
By224-600
C1810 22N
L1801
L1802
Z26
C1809 22N
F1 3,15A DELAYED ACTION (2x) F2
S25
MAINS
R1811 3
V1806 BU208
L1804
L1806
C1804 47N
V1811 By208-1000
C1808 48,7N
R1817 10M
C1807 48,7N
R1818 10M
R1812 100
R1813 10
V1807 BAX12
V1808 By208-1000
V1809 By208-1000
R1814 20
R1816 2K
C1806 220P
L1803
R1807 110K
R1803 1M
R1806 PTC 1500Ω at 25°C
R1808 110K
V1804 BC549C
V1803 BUX86
R1804 3,3K
R1838 12,1K
R1837 249
R1839 249
V1814 BAW62
R1841 140
V1816
V1817
V1818
V1819 By206 (4x)
L1807
R1822 205K
R1834 3,32K
R1819 5,11K
R1821 33,2K
V1810 BZX79-C12
R1823 1K
R1824 100K
R1836 6,81K
R1842 1
R1826 10K OVERLOAD
D1801 TDA1060
V1812 BC549C
C1816 10µ
C1817 100N
C1818 10µ
V1813 BZX79-C12
C1819 33µ
C1821 22µ
+8,4V
R1833 5,62K
R1831 162K
R1827 22,6K
R1828 470
VOUT
C1811 4,7N
C1812 3,3N
FREQ.
R1829 10K
C1814 10µ
R1832 4,64K

MA10053


C1802 (-) ,C1803 (+)
MAINS INPUT
6. T1801
4. T1801 ,C1802 (+)
C1803 (-)
T1801
1
2
N
C1805
L1801
L1802
V1802
V1801
R1839
V1818
V1819
V1817
V1816
R1841
V1814
C1818
C1816
R1808
R1804
R1807
R1803
C1810
R1827
C1809
OVER LOAD
R1826
R1819
C1817
V1813
R1837
V1810
R1821
R1836
V1812
R1838
V1804
V1803
R1842
C1819
C1821
L1807
R1822
D1801
16
9
1
8
R1829
FREQ.
C1812
R1831
R1832
V1807
R1813
C1814
C1811
R1824
R1834
R1833
R1823
VOUT
R1828
C1807
C1808
R1806
R1801
R1802
R1818
R1817
R1816
R1814
V1809
C1804
V1811
C1806
L1804
V1808
R1811
L1806
L1803
R1812
C
E
V1806
B

MA10063


T1801
10
V1863
L1863
+5V
V1864
C1863
4700µ
V1871
BZx87-C5v6
SD41 (4x)
13
0V
V1866
C1864
4700µ
V1872
BZx87-C5v6
16
V1867
L1864
-5V
21
V1868
L1866
-2V
C1866
1000µ
22
25
V1869
IN5820 (2x)
V1882
BD435
+12V
R1869
75
V1883
BZX75-C3V6
4
5
(+)
D1851
R1871
100
BC559B
7
6
(-)
11
V1884
A
R1872
3,16K
R1873
2,61K
R1863
649
R1864
178
+12V
100
R1868
V1881
BZx91
470
R1867
1,47K
R1866
100
R1874
R1877
100K
+5,4V
R1876
38,3K
2
(-)
D1851
1
R1878
511
BD201
3
(+)
V1886
20
V1873
L1867
By206 (2x)
C1867
330µ
V1874
22
V1876
L1868
C1868
330µ
24
26
V1877
V1878
L1869
C1869
330µ
27
V1879
Byx55-600 (4x)
A
V1888
BD202
-11,4V
R1879
649
R1881
178
-11,4V
R1886
38,3
V1889
BZX75-C3V6
V1887
BZx91
470
R1883
R1884
100
10
(+)
D1851
R1887
100
BC549C
8
9
(-)
V1891
1,47K
R1882
R1888
3,16K
D1851 = LM324N
2,61K
R1889
T1851
1
F
C.R.T.
2
F
4
1KV~
10
5
REG
0'
6
V1892
+150V
C1871
680
C1872
470N
12
7
V1893
8
V1894
+50V
C1873
22µ
9
V1896
V1897
-50V
By 206
(6x)
C1874
22µ
GREEN
10M
R1861
9KV C.R.T.
V1851...
1861
WHITE
C1851...
1861
MA10052


T1801 CONNECTION
CENTRE ROW
TOP ROW
20
26
24
+5,2V
13
-5V
+5V
25
27
22
-11,4V
12
10
16
F
F
T 1851
V1876
V1877
V1879
V1878
V1874
V1873
L1866
V1868
V1869
C1866
+
V1864
V1863
L1863
TO H.T. MULTIPLIER
TO FOCUS UNIT
1kV~
C1871
V1892
V1893
V1894
V1897
V1896
L1869
C1863
O'
(REG)
C1868
C1872
C1867
C1873
C1874
C1869
L1867
L1868
V1883
R1869
V1884
V1889
V1891
R1886
R1887
R1889
R1888
R1884
D1851
R1871
R1872
R1873
R1868
R1874
R1876
R1878
R1877
V1882
V1886
R1867
+12V
R1863
V1881
R1864
R1866
V1871
L1864
V1872
C1864
V1867
V1866
+12V
R1879
V1887
R1881
R1883
R1882
V1888
-11,4V
-11,4V
+5,4V
+12V
-2V
-5V
+5V
MA10064

CODING SYSTEM OF FAILURE REPORTING FOR QUALITY ASSESSMENT OF T & M INSTRUMENTS

(excl. potentiometric recorders)

The information contents of the coded failure description is necessary for our computerized processing of quality data.

Since the reporting of repair and maintenance routines must be complete and exact, we give you an example of a correctly filled-out PHILIPS SERVICE Job sheet.

① Country	② Day Month Year	③ Typenumber /Version	④ Factory/Serial no.
32	150475	0PM3260/02	DO 0783

CODED FAILURE DESCRIPTION ⑥

⑤ Nature of call	Location	Component/sequence no.	Category
☐ Installation		TS0607	5
☐ Pre sale repair		R00631	2
☐ Preventive maintenance	0021	990001	4
☒ Corrective maintenance			
☐ Other			

⑦ *Job completed* ☒

Working time ⑧ ☐☐12 Hrs

Detailed description of the information to be entered in the various boxes:

①Country: 32 = Switzerland

②Day Month Year 150475 = 15 April 1975

③Type number/Version OPM3260/02 = Oscilloscope PM 3260, version 02 (in later oscilloscopes this number is placed in front of the serial no)

④Factory/Serial number DO0783 = DO 783 These data are mentioned on the type plate of the instrument

⑤Nature of call: Enter a cross in the relevant box

⑥Coded failure description

Location

☐☐☐☐

These four boxes are used to isolate the problem area. Write the code of the part in which the fault occurs, e.g. unit no or mechanical item no of this part (refer to 'PARTS LISTS' in the manual).

Example: 0001 for Unit 1
000A for Unit A
0075 for item 75

If units are not numbered, do not fill in the four boxes; see Example Job sheet.

Component/sequence no.

☐☐☐☐☐☐

These six boxes are intended to pinpoint the faulty component.

A. Enter the component designation as used in the circuit diagram. If the designation is alfa-numeric,the letters must be written (starting from the left) in the two left-hand boxes and the figures must be written (in such a way that the last digit occupies the right-most box) in the four right-hand boxes.

B. Parts not identified in the circuit diagram:

990000 Unknown/Not applicable
990001 Cabinet or rack (text plate, emblem, grip, rail, graticule, etc.)
990002 Knob (incl. dial knob, cap, etc.)
990003 Probe (only if attached to instrument)
990004 Leads and associated plugs
990005 Holder (valve,transistor, fuse, board, etc.)
990006 Complete unit (p.w. board, h.t. unit, etc.)
990007 Accessory (only those without type number)
990008 Documentation (manual, supplement, etc.)
990009 Foreign object
990099 Miscellaneous

Category

☐

0 Unknown, not applicable (fault not present, intermittent or disappeared)
1 Software error
2 Readjustment
3 Electrical repair (wiring, solder joint, etc.)
4 Mechanical repair (polishing, filing, remachining, etc.)
5 Replacement (of transistor, resistor, etc.)
6 Cleaning and/or lubrication
7 Operator error
8 Missing items (on pre-sale test)
9 Environmental requirements are not met

⑦Job completed: Enter a cross when the job has been completed.

⑧Working time: Enter the total number of working hours spent in connection with the job (excluding travelling, waiting time, etc.), using the last box for tenths of hours.

☐☐12 = 1,2 working hours (1 h 12 min.)

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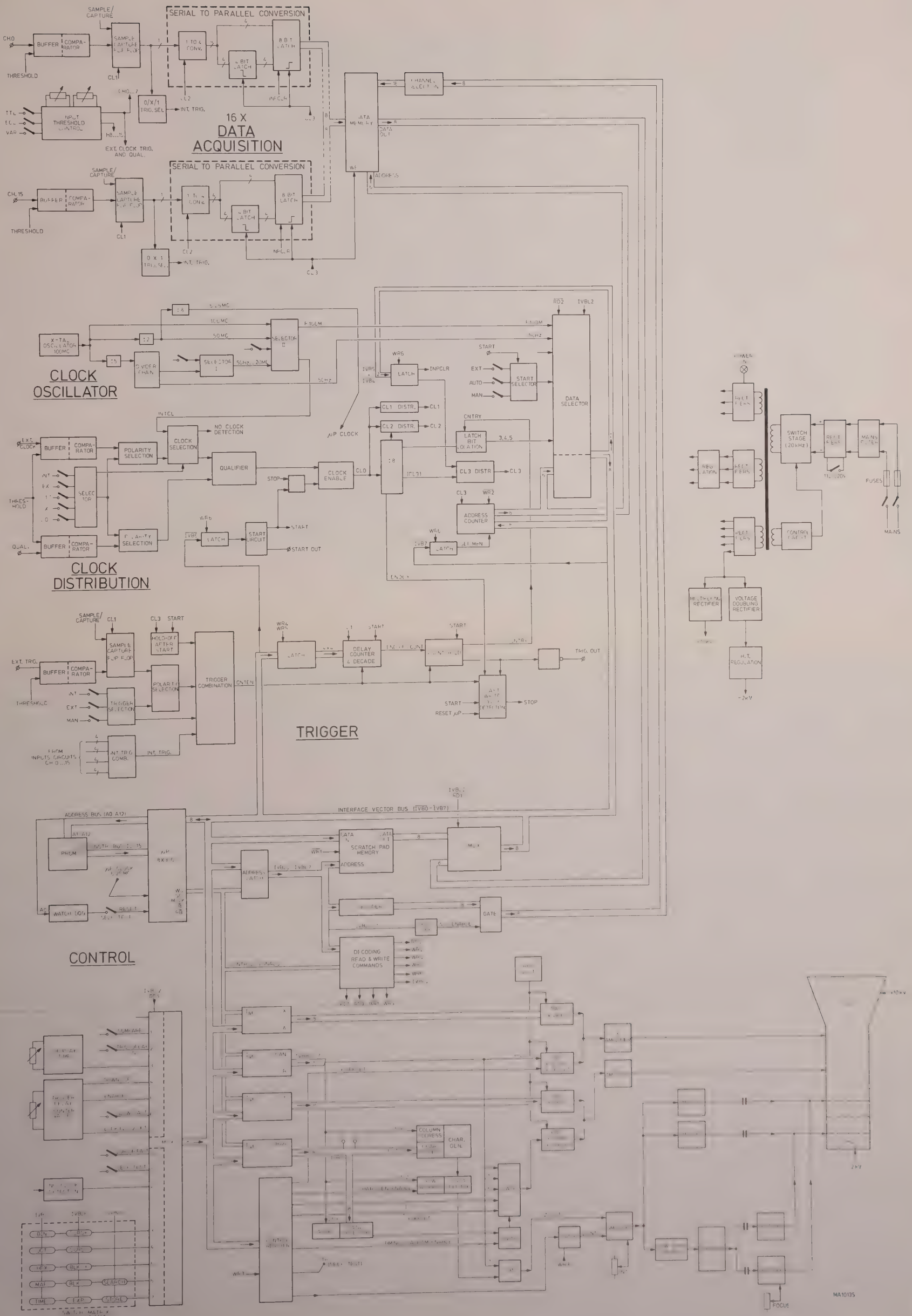
SERIAL TO PARALLEL CONVERSION
16 X
DATA
ACQUISITION
CLOCK
OSCILLATOR
CLOCK
DISTRIBUTION
TRIGGER
CONTROL
DATA SELECTOR
SCRATCH PAD MEMORY
DECODING READ & WRITE COMMANDS
INTERFACE VECTOR BUS (IVB0-IVB7)
ADDRESS BUS (A0 A12)
MULTIPLYING RECTIFIER
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Logic Analyzer PM3500

Fig. 1 PM3500 Front view

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1. **Cathode ray tube**

The tube has been provided with a safety-glass face plate.
Accordingly the c.r.t. bezel has been changed, the new bezel is mounted with two M3 Allen key screws.
The code numbers for the cathode ray tube and the bezel have not been changed.

2. **Unstable microprocessor control**

A. This could be caused by bad prom-socket contact properties (D 1301 -- 1307).

Check the soldering of these sockets (24 pins).

The gold-plated prom-sockets (which hold I.C.'s with tin-plated pins) might cause persistent contact problems.
In this case replace this sockets by the tin-plated types code number 5322 255 40248.

The same applies to the sockets of D1316, 1317, 1318, 1319 and D1321.
Tin plated sockets for the 16 pin I.C.'s D102, 202, 302, 402, 502, 602, 702, 802, 902, 909, D1313, 1314 and D1336, 1337 have code number 5322 255 44218.

B. Connect a 15 pF capacitor between pin 3 and pin 7 of IC D1344 (N74S11N) on the microprocessor board.
This capacitor suppresses spurious spikes on the MCLK line.

PM3500's from approx serialnr. D900 on, have already been provided with correct sockets and the above mentionned capacitor.

If repairing of the microprocessor board is difficult you can send him to concern Service conform the standard G2 routing.

3. **Clock, trigger unit**

Some coaxial connectors on this unit may cause short-circuit with other circuits on the upper side of the p.c. board.

Check connectors nr. 4, 5, 11 and others.
Insert insulation washer 5322 466 94648, if necessary.

Fig. 2 Coaxial connector with underlaying circuit

4. **Connectors**

Check the power supply connectors on the microprocessorunit and the clock-trigger unit.
(The connectors may go loose due to the rather stiff cables).

5. **Coils L1061, 1062**

0,33 μH - 0,17 ohms code number 5322 158 10282.

6. **Erratum Fig. 7a Instruction Manual 9499 503 00602**

The anode of diode V905 has not been connected to D937 p.13, but to the cathode of V910.

7. The correct code number for the pin adaptor (item 6 in the parts list of the PM 8800 probe) is 5322 263 54013.

8. Microprocessor bus system

The microprocessor 8X300 is provided with an addressbus, an instructionbus and an IV-bus. Generally these busses are connected to a number of IC's.

If one device connected to the bus is defective (short-circuit to ground, or to the supply voltage) the corresponding busline is faulty over the whole extend.

In case of excessive current flow, a current tracer could be used as indicated in Fig. 3.
Even if the bus lines cannot be traced over the whole extend the current flowing through the connection pins of the IC's can be checked.

The following lists indicate all points which are connected to the microprocessor busses.

Microprocessor Address bus

		D1308 Microproc. pin no.	D1301	1302	1303	1304	1306	1307	X1304
(l.s.b.)	A12	45 →	8	8	8	8	8	8	20
	A11	46 →	7	7	7	7	7	7	18
	A10	47 →	6	6	6	6	6	6	17
	A9	48 →	5	5	5	5	5	5	15
	A8	49 →	4	4	4	4	4	4	14
	A7	2 →	3	3	3	3	3	3	12
	A6	3 →	2	2	2	2	2	2	11
	A5	4 →	1	1	1	1	1	1	9
	A4	5 →	23	23	23	23	23	23	8
	A3	6 →	22	22	22	22	22	22	6
	A2	7 →	20	20	20	20	20	20	5
	A1	8 →	21	21	21	21	21	21	3
(m.s.b.)	A0	9 →	–	–	–	–	–	–	R1310

Microprocessor Instruction bus

		D1308 Micro proc. pin no.	X1305	D1301,	1302,	1303,	1304 ,	1306 ,	1307	
(l.s.b.)	I15	28 →	32	9			9		9	
	I14	27 →	30	10			10		10	
	I13	26 →	28	11			11		11	
	I12	25 →	26	13			13		13	R1359
	I11	24 →	24	14			14		14	
	I10	23 →	22	15			15		15	
	I9	22 →	20	16			16		16	
	I8	21 →	18	17			17		17	
	I7	20 →	16		9		9	9		
	I6	19 →	14		10		10	10		
	I5	18 →	12		11		11	11		
	I4	17 →	10		13		13	13		R1361
	I3	16 →	8		14		14	14		
	I2	15 →	6		15		15	15		
	I1	14 →	4		16		16	16		
(m.s.b)	I0	13 →	2		17		17	17		

Microprocessor IV-bus

		D1308	D929	D931	D934	D938	D939	D942	D943	D944	D946	D1316	D1317	D1318	D1319	D1322	D1323	D1324	D1326	D1327	D1328	D1329	D1331	D1332	X1302	X1304
(l.s.b.)	$\overline{IVB7}$	33 →	13	2	–	–	4	3	–	2	–	23	23	23	23	–	7	2	–	4	12	–	12	–	8	32
	$\overline{IVB6}$	34 →	3	3	–	–	7	2	–	3	–	22	22	22	22	7	–	3	–	5	9	–	9	–	7	31
	$\overline{IVB5}$	35 →	11	6	–	–	9	6	–	6	–	21	21	21	21	–	6	6	–	6	4	–	4	–	6	29
	$\overline{IVB4}$	36 →	9	7	–	–	12	7	–	7	–	20	20	20	20	6	–	7	–	7	7	–	7	–	5	28
	$\overline{IVB3}$	38 →	–	–	12	4	–	–	2	–	2	19	19	19	19	3	–	–	2	8	–	12	–	12	4	26
	$\overline{IVB2}$	39 →	–	–	10	7	–	–	3	–	3	18	18	18	18	–	3	–	3	9	–	9	–	9	3	25
	$\overline{IVB1}$	40 →	–	–	–	9	–	–	6	–	6	17	17	17	17	2	–	–	6	10	–	4	–	4	2	23
(m.s.b.)	$\overline{IVB0}$	41 →	–	–	–	12	–	–	7	–	7	16	16	16	16	–	2	–	7	11	–	7	–	7	1	22

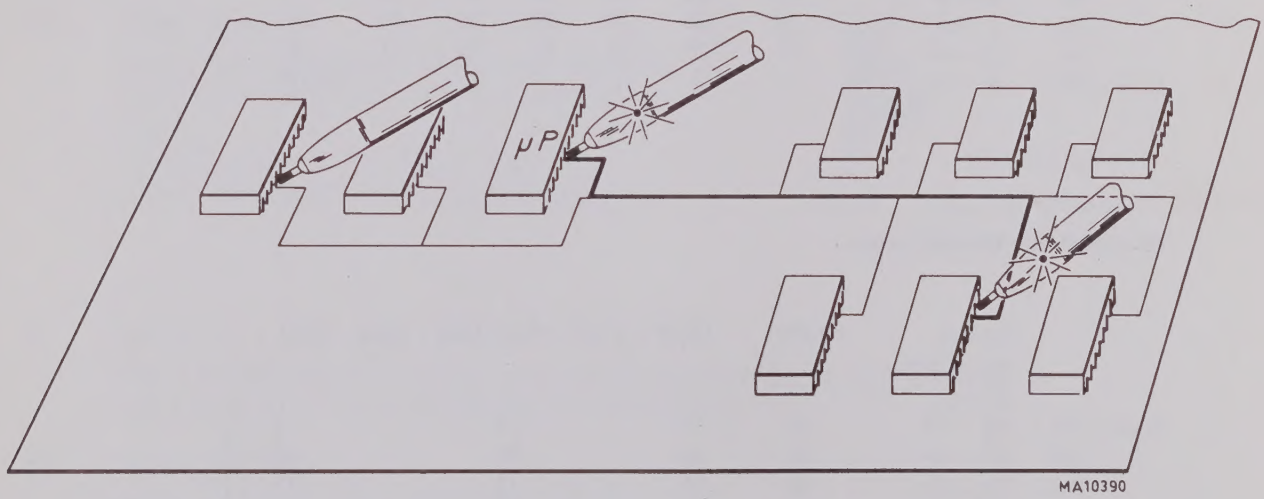

Fig. 3 Tracing excessive current flow

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